FAST FOOD, FAKE FOOD AND STREET FOOD, SLOW FOOD, ORGANIC FOOD AND VEGAN FOOD ... WHAT'S NEXT?

Albert SASSON

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Jacques-François Ancelot
A French writer and playwright
(1794-1854)

"*Oui, mieux que la raison, l'estomac nous dirige*"
(Yes, better than the reason, it's the stomach that steers us)

N.B. Perhaps, nowadays, it's more than that …

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PREFACE

The Hassan II Academy of Science and Technology has been created by a Royal Decree, on 6 October 1993, and enjoys the protection and tutorship of His Majesty the King of Morocco. In 2016, the Academy has celebrated the 10th anniversary of its official installation by His Majesty Mohammed VI, King of Morocco. Now, after almost 14 years of activity, the Academy has been successful in promoting scientific and technological research, particularly through assessing, supporting and funding research programmes and projects; in issuing recommendations on the national science and technology policy and strategies; and in contributing to the advancement of scientific knowledge and culture.

In addition to the *Proceedings* of its sessions, the Academy publishes an *Electronic Journal* in English, a *Bulletin* and a *Newsletter*. It also supports publications and reports dealing with subjects of relevance to its scientific sections. In 2020, the decision was made to create the Hassan II Academy Press. This will consist of a series of books and publications, that are different from the other Academy's publications, but are nevertheless very close to its activities – promotion of research and development and of scientific culture.

This book has been selected to be part of this new Academy's initiative. It recalls that the primary goal and top priority of our civilization are to eliminate extreme poverty, undernutrition and starvation still prevailing among hundreds of millions of people. In 2019-2020, this situation has been worsened by the Covid-19 pandemic. On the other hand, over the last two decades, we have noticed the emergence of a wide-range of eating habits that largely reflect societal changes; as well as the setting up of business strategies of the large agrifood multinationals and big food distributors. At the same time, nutritional and medical research brought in evidence of the close relationships between health and eating and drinking habits. Both the agrifood multinationals and big food distributors are therefore trying to meet the consumers' concerns about their health and environment protection. Furthermore, we have been watching the qualification of food as fast food, street food, slow food, organic and vegan food, as well as the aggressive advertisement and communication campaigns across the world that blamed or praised these kinds of foods. On the gastronomic side, we have witnessed and we are still seeing a marked trend of blending culinary traditions; this multiculturalism or fusion of cuisines is set to last. Finally, part two and three of the book deal with a selection of food ingredients and beverages.

Like former books authored by Professor Albert Sasson, published or co-published by the Hassan II Academy of Science and Technology – the last one, published in 2016, has dealt with *Medical Biotechnology* – this book also aims to provide the readers with the opportunity to understand some key societal changes – in the present case food and eating habits – and to develop informed opinions about them. In this regard, it should be underlined that Professor Albert Sasson enjoys a long-standing reputation for disseminating scientific and technological knowledge, especially with respect to biotechnology in developing countries over the last 48 years.

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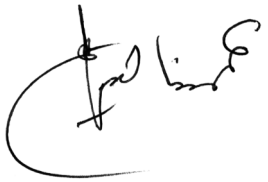

FOREWORD

Over several years, a new cultural trend has moved food at the forefront of everybody's health and social life. Besides the physiological needs to feed our organism, like any other living being, it cannot be denied that television screens and radio announcements are, in their vast majority, advertising not only food items in a repetitive and consistent way, but they deal with a wide range of issues: how to feed oneself, to avoid fats, sugar and obesity, how to lose weight in order to remain slender and attractive, how to choose the right food items and to be more careful about the provenance of agrifoods as well as about the ingredients of transformed foodstuffs.

We are being confronted with a number of phrases that qualify the food we consume, such as fast food, often also called junk food (with the highly sweetened beverages that accompany it); slow food to oppose fast food not only because of its content, nutritional value, but also because it involves short circuits between the farmers and consumers; street food and food trucks; vegan food with various scales of discriminating foods derived from domestic animals; and of course organic ("bio") food.

Two or three decades ago, we used to notice in the various means of communication (press, radio and television), among the reasons to travel to and visit countries, an emphasis on their exceptional natural sites, cultural monuments and museums and traditions. We were thus trained, especially the non-specialists, about how to better understand the peoples we were going to visit, their cultural achievements and the various facets of their culture (or at least to have a glimpse of it). Food was mentioned, with some health advices, but in general as something worth to be discovered and enjoyed.

But food was not, like nowadays, at the forefront of information and it has become part of the advertisement policies aimed at attracting tourists. Thus we are informed about the typical and traditional meals, their origins and how to enjoy them best; about where to eat, from the streets to the high-end star-awarded restaurants. Furthermore, gastronomical articles or supplements exist in all daily newspapers and magazines. Indeed, there is no way to escape this invasive trend.

The delights of gastronomy and their geographical distribution across the world, although quite often within the reach of wealthy people, blur the frontier with healthy eating. The latter does not necessarily rely on sophisticated and costly preparations, but on quality and diversified food ingredients, that are not overcooked. Some renowned

chefs have recently decided to abandon the stars awarded to their restaurants, to forget about the high-end of their gastronomical style as well as the ceremonial welcome and distinguished service versus their guests; and to come back to an affordable, simple and healthy cuisine.

That being said, what biomedical science and nutrition have to say on the eating habits, on what we should avoid to eat or lower some intakes of our diet portions, and which are the healthy combinations of food? The nutritional recommendations raise the whole issue of the food ingredients, i.e. the relevant regulations on the ways to mention them or to display them through digital means for each kind of transformed food. But despite those regulations, is the information given to the consumers sufficiently legible and well understood by them? How to find amidst all this information, sometimes puzzling or confusing, the right balance between health and pleasure? In other words, can we eat healthy foodstuffs that are also tasteful (taking account of the wide range of culinary traditions), and at an affordable price? Besides the food scandals which induce the consumers' defiance and suspicion, is the food industry helping to reach that goal?

But make no mistake: is it acceptable to overstate the wide-ranging comments about food, mainly for the middle and upper classes, without primarily emphasizing the very sad reality of the hundreds of millions of people across the world who suffer from starvation, undernutrition and all forms of malnutrition? This situation is a shame of our civilization, because when we see so many signs of wealth and opulence throughout the world, we cannot accept that so many poor or very poor people survive with less than US$1 a day. In 2019-2020, the Covid-19 pandemic has worsened these conditions and even created the new poor in several industrialized countries (see pp. 21-32 and Epilogue, p. 405).

It is fine to speak about food, eating habits, gastronomy, nutrition, and so on, but we must above all eradicate this extreme poverty and starvation, quickly and worldwide. This goal is not only a fundamental duty for every nation, but it must be a top priority of the United Nations' sustainable development goals (GSDs), which followed the millennium development goals (MDGs). There are several good examples of countries which have given a high priority to agriculture and food production, and thus have reached the goal of eradicating extreme poverty and hunger; moreover, they have succeeded to move up a large proportion of their population to lower and upper middle classes. These examples (see further) are not necessarily templates, but a lot of useful lessons and approaches can be learnt from them.

SUMMARIZED CONTENTS

PART ONE

MULTIPLE FACETS OF EATING... AND DRINKING

CONTENTS

TOWARD ERADICATING EXTREME POVERTY AND HUNGER

The figures

In 2000, the international community made the commitment to halve extreme poverty by 2015 worldwide. That was the millennium development goal no. 1. In 2011-2012, the results were far from being satisfactory: some 15 countries seemed to have achieved the goals, but many more were far from that. For instance, almost one African out of two still lived with less than US$1.25 per day – considered as the threshold of extreme poverty by the United Nations. Regarding the reduction of poverty, according to the figures of the World Bank, a lot of the credit goes to China. Half of the long-term decline was attributable to that country alone which had taken 660 million people out of poverty since 1981. Every year, according to Chinese estimates, *ca*. 10 million people are drawn out of extreme poverty. China also accounted for most of the extraordinary progress in East Asia which in the early 1980s had the highest incidence of poverty in the world with 77% of the population living below US$1.25 a day. In 2008, that share was just 14% (cf. Sasson, 2013).

It should be underlined that progress had been concentrated among the poorest of the poor – those who survived with less than US$1.25 a day. The World Bank's figures showed only a small drop in the number of those who lived with less than US$2 a day, from 2.92 billion in 1981 to 2.44 billion in 2008. On 15 September 2010, the Food and Agriculture Organization of the United Nations (FAO) had published its estimates concerning the number of people suffering from hunger: 925 million. This figure meant 13.5% of the global population, while with respect to the 2015 millennium development goal (MDG) it meant 8% (cf. Sasson, 2013).

A few days before the 39th session of the United Nations Committee for Global Food Security (CGFS) that took place at the FAO headquarters in Rome from 15 to 20 October 2012, the report published on 9 October 2012 by the United Nations on the status of food insecurity in the world recalled the need to increase the efforts made to control hunger and malnutrition. The figures were still alarming: the number of people suffering from chronic undernutrition in the developing countries amounted to 852 million (or 14.9% of the world's population). The starvation (or hunger) index in the world published on 11 October 2012 by the International Food Policy Research Institute (IFPRI, Washington, D.C.) and several NGOs showed that "20 countries continued to have an extremely alarming, or alarming index." Most of these countries were located in sub-Saharan Africa or South Asia – the region of the world with the highest number of persons living in food-insecurity conditions (cf. Sasson, 2013).

On 11 September 2018 and on the eve of the 73rd session of the United Nations General Assembly, the FAO published a report, in association with the International Fund for Agricultural Development (IFAD), UNICEF, the World Food Programme (WFP) and the World Health Organization (WHO), titled *The State of Food Security and the Nutrition in the World 2018. Building Climate Resilience for Food Security and Nutrition* (FAO et al., 2018). Despite the progress made in reducing the number of starving and undernourished people in the world (618.9 million and 784.4 million, respectively, in 2015), the figures in 2017 were still alarming; for the third consecutive year, the numbers of starving and undernourished people were almost equal to those ten years back: 769.4 million and 820.8 million, respectively. Between 2016 and 2017, these numbers (starving and undernourished people) increased from 665.7 million to 769.4 million, and from 804.2 million to 820.8 million, respectively (FAO et al., 2018).

Consequently, the objective for sustainable development (OSD) no. 2, "zero hunger", set up for 2030 by the United Nations in 2015, cannot be achieved. Not only poverty or extreme poverty (with its multiple causes, from governance and social justice to the technical ability to supply enough food) continues to be the main explanation of these unfortunate figures, but other reasons like many more extreme weather phenomena and climate change, as well as conflicts and economical crises, were highlighted in the FAO report. Climate change, indeed, becomes a primary cause of starvation and undernutrition across the world today. The percentages of population suffering from high food insecurity were 10.2% in the world in 2017 (compared with 8.9% in 2014); 29.8% in Africa (compared with 22.3% in 2014); 9.8% in Latin America (7.6%); 6.9% in Asia (7.3%); and 1.4% in North America and Europe (compared with 1.5% in 2014) [FAO et al., 2018].

In 2017, the numbers of undernourished people reached *ca*. 575 million in countries heavily exposed to extreme weather phenomena (extreme heat, recurrent droughts, floods and tempests for more than three years over the period 2011-2016), and *ca*. 225 million in countries less exposed to extreme weather variability. Between 2004 and 2015, the FAO estimated that in Africa, drought caused a loss of harvests and livestock of *ca*. US$10 billion, while the estimated loss was *ca*. US$12.5 billion in Latin America and the Caribbean, and in Asia it was more than US$5 billion (FAO et al., 2018).

For the 73rd session of the United Nations General Assembly, the FAO requested "large-scale funding to support programmes aimed at reducing and managing the risks of catastrophes and adaptation to climate change." According to the United Nations agency, the humanitarian assistance to the countries affected by climate change should be reviewed: "After a catastrophe, lives must be saved of course, but this is not enough. Beyond emergency, long-term solutions should be promoted, so as to mitigate the vulnerability of the most affected countries," stated Dominique Burgeon, director of the FAO division for emergencies. Global warming and its consequences are the culprit, even though the FAO carefully made the prevision that climate change is not the only cause of what is happening in terms of starvation and undernutrition across the world. Nevertheless, global warming has an impact on weather variability which results in a shortening of the cropping time (due to extreme temperatures

and rainfall vagaries). "In 2017, 124 million people in 51 countries have been facing food-security crises and needed urgent food assistance. In 34 out of these 51 countries, the primary cause of that situation was related to climate shock," explained D. Burgeon (FAO et al., 2018).

According to the FAO, floods cause more catastrophes than other extreme weather events. They showed their biggest increase (+65%) over 25 years. Asia is the most affected region, while in Africa, floods decreased in intensity over the last dozen years. The occurrence of ocean tempests and tropical hurricanes was not higher than that of floods, but they are still the second cause of catastrophes linked to climate change. In Pakistan, weather-related catastrophes (hurricane in 2007 and floods in 2007, 2010 and 2011) have caused losses estimated at €6.6 billion, a figure fourfold higher than the state's budget devoted to the agricultural sector between 2008 and 2011. According to the above-mentioned FAO report, "In Malawi, an increase in temperature of 1° Celsius makes the global consumption per inhabitant to fall by 20% and the calorie diet by *ca*. 40%." The FAO highlighted the decrease in nutritional quality, the increased incidence of diseases in humans and livestock and delayed growth rates. In East Africa, for instance, the implications of the El Niño variations were followed by an epidemic outbreak of a viral disease in livestock, called the Rift Valley fever. "In 2006 and 2007, such kind of fever killed more than 420,000 sheep and goats, and the losses of milk have been estimated at more than 2.5 million litres, largely due to the miscarriages in small ruminants and dromedaries," indicated the same report (Barroux, 2018b; FAO et al., 2018).

The 2018 World Bank Report

The World Bank Report, titled *Poverty and Shared Prosperity 2018. Piecing Together the Poverty Puzzle* (World Bank, 2018), and published on 19 September 2018, gave similar figures to those found in the FAO report: out of a total 736 million people living with less than US$1.90 (€1.62) per day in the world, Africa was home of more than half of them (413.3 million) in 2015. According to the World Bank, poverty rate slumped to 10% of the global population; and in 2018 it fell down to 8.6% But the first of the 17 objectives of sustainable development, adopted by the United Nations in 2015, was to decrease this poverty rate (e.g. people living under the threshold of poverty) to less than 3% of the global population in 2030. "Can this objective be reached?" wondered the World Bank director of the poverty unit, Carolina Sanchez-Paramo. The task would not be easy, although the report gave a few good news (De Vergès, 2018; World Bank, 2018).

In 1990, the world's poverty rate was *ca*. 36%. Since then, more than 1.1 billion people were drawn out of misery thanks to the improvement of their living conditions. Nevertheless, the World Bank experts were concerned about the slowing down of the process and about the geographical disparities of the global distribution of very poor people. Thus, the outstanding development of China has changed the landscape: in 2015, only 2.3% of the population in East Asia and the Pacific were reported to live under the threshold of poverty (US$1.90 per day). Meanwhile, the concentration of poverty has moved to South Asia and, since 2010, to sub-Saharan Africa (World Bank, 2018).

It is true that in sub-Saharan Africa the poverty rate had decreased since 1990: 54.3% compared with 41.1% in 2015. However, the number of the extreme poor has relentlessly increased along with the population growth rate. While in 2015 India was still home of the highest number of very poor people across the world (170 million people), Nigeria with a total population of 190 million people may be soon in this sad situation. Out of the 27 countries with the highest poverty rate across the world, most of them were in sub-Saharan Africa. It is no surprise that very poor people are more numerous in the countries stricken by political crises and armed conflicts. Many of them are found in sub-Saharan Africa, but also in the Near and Middle East. Between 2003 and 2015 the population of very poor people had doubled in the North Africa and Middle East (MENA) region, thus reaching 5% of the whole population (World Bank, 2018).

Many African countries are suppliers of raw materials and their economic growth does not generally trickle down to those who are at the bottom of the income scale. Thus economic growth is source of social inequalities and does not create enough jobs. As a result, the World Bank experts foresee that "poverty rate would remain a two-digit number from 2018 to 2030, unless a real change occurs in policy." This statement should be interpreted in the broad sense, explained Carolina Sanchez Paramo: "To be poor is not just an issue of income and level of consumption, but it also means a lot of handicaps relating to the access to education, health care and drinking water, and to climate-change vulnerability" (De Vergès, 2018; World Bank, 2018).

Bill and Melinda Gates Foundation overview

The Bill and Melinda Gates Foundation has also issued a report on progress and youth demographics in sub-Saharan Africa. In an article published on the 26 September 2018 issue of *The New York Times International Edition* issue, Bill and Melinda Gates have given their overview on the progress of poverty worldwide (Gates and Gates, 2018). They started by stating that more than a billion people have overcome poverty just since the turn of the millennium. They considered that "this huge drop in the number of people living on less than US$1.90 per day is among the most underappreciated and most important development of our generation." But this "progress" is not guaranteed to continue. The number of people in extreme poverty will stagnate at over 500 million. This figure is much lower than the forecast of the World Bank report (736 millions, see above p. 19).

While extreme poverty tends to disappear from many places, including China and to a lesser extent India, it is still present and concentrated in Africa, particularly in a dozen countries in sub-Saharan Africa, confronted with violent conflicts, severe climate changes, weak governance and dismantled health and education systems. Bill and Melinda Gates thereafter underlined that these dozen countries have a population growth rate that is much faster than in any other place in the world. For instance, in the United States, women have an average of two children, while in Niger – one of the poorest countries in the world – they have an average of seven. Moreover, births are rather concentrated in the places where poverty prevails: adults have to devote

most of their resources to survival, leaving very little to invest in their families and children. According to Bill and Melinda Gates, the persistent poverty in fast-growing places explains why, by 2050 and in all likelihood, more than 40% of the extremely poor people in the world would live in just two countries: the Democratic Republic of Congo and Nigeria (Gates and Gates, 2018).

Bill and Melinda Gates do believe that investments in education and health-care systems, and even in science and technology pay off. For instance, in 1990, a typical Chinese young person received an eighth-grade education, while nowadays he or she receives some college education, thanks to the government and investment in education. In 1990, one out of three Chinese children were chronically malnourished. Now, it is fewer than one out of ten, thanks to improved agricultural productivity and health care. Both authors say that the challenge is that today's poorest and fastest-growing countries should make the same kinds of investments; if they do so, extreme poverty may disappear from the Earth. They appeal to the youth in sub-Saharan Africa to be the driving force of this cultural change, so as to transform farms into profitable small businesses, to eradicate malaria and other neglected diseases, and fully enter into the digital world. They end up their overview by stating that recent history shows that progress is possible, even under what experts used to consider impossible circumstances. Precisely, the work of the Bill and Melinda Gates Foundation tries to read that objective (Gates and Gates, 2018).

2020: the Covid-19 pandemic – an additional food and hardship crisis for the poor and the new poor across the world

In 2020, an unprecedented pandemic that started in the Chinese province of Hubei and in its capital Wuhan, has submerged several Asian countries, then Europe, Latin America, United States, and, to a lesser extent, sub-Saharan Africa and the Pacific. The pandemic is caused by an unknown corona virus whose animal reservoirs are tropical bats and a few infected mammals the flesh of which is eaten by some human populations. It is more infectious and contagious than the first coronavirus, SARS-CoV (Severe Acute Respiratory Syndrome- Coronavirus). The latter has caused in several Asian Countries severe lung diseases (viral pneumopathies) in 2002-2004. In 2020, and since probably the end of 2019, the new virus, named SARS-CoV-2, has caused a heavy death toll, particularly among senior and old people, often suffering from other chronic diseases. Young people, under 50 years old, and children have been less affected, although many among them can be asymptomatic, i.e. with no pathological symptoms (e.g. fever, cough, respiratory ailments) but bearing nevertheless the virus in their respiratory system, and therefore capable of infecting other healthy people. The disease, named Covid-19, is a *systemic* disease because the virus attacks not only the respiratory system, but many other organs. Although the overall mortality is much lower than that of seasonal flu, it is quite significant among the elders. It should be mentioned that another coronavirus affected in 2012 several Middle-Eastern countries, the Middle-East Respiratory Syndrome or MERS, the animal reservoir of which is the dromedary. See Epilogue, p. 405.

Within a few months, at the beginning of 2020, there has been an amazing acceleration of biomedical research and basic investigations on the virus and the disease across the world, mainly in China, the United States and Western Europe. Following the sequencing of the genome of this RNA-virus, scientists and physicians have described how the virus enters human lung cells, as well as the various symptoms of the disease (with the help of sophisticated imagery), the immunological disorders caused by the virus and their deadly implications. National health systems, and particularly the hospitals, have been shattered. The majority of the seriously affected patients needed to be treated in intensive-care units in order to provide them with artificial oxygen respiration. The capacities of these units had to be increased in a hurry and they were often on the brink of collapsing. In the absence of an effective vaccine and therapy, the only way to slow down the contamination and the virus outbreaks or clusters was, in addition of a series of hygienic measures – washing hands frequently, physical distanciation, bearing disposable masks and gloves – the lockdown of the population. The latter could be very strict, sometimes using a curfew, just enabling short walks to purchase food; in a few countries, a more relaxed confinement was adopted but it can become very strict if the data collected about the virus circulation were considered worrying. By the end of May 2020, a series of measures enabled people to move outside their household and go back to work; schools were partially or totally opened (but not the universities); parks and gardens opened progressively, as well as touristic sites. But all these so-called de-confinement measures were under the monitoring of epidemiologists, physicians, virologists, and also artificial-intelligence specialists who were in charge of the daily interpretation of the data regarding the speed of the contamination with the virus, the number of hospital admissions, of deaths and recoveries. These data can feed mathematical models on the evolution of the disease and therefore guide the reaction of the national health systems.

During the period from March to May 2020, the economy of the countries affected by the Covid-19 has been at stand still, except for meeting basic needs. In other words, in addition to a major sanitary crisis, that is far from over – the only hope of relief being the rapid discovery of effective vaccines, as well as of appropriate therapeutic treatments – a deep economic and social crisis may probably last even more. Because of soaring unemployment, a drastic decrease in household's income, the almost absence of a social net, and particularly of disease insurance, the social crisis will probably hit more than the sanitary one and could even lead to a destabilization of some political regimes. In fact, a very perceptible aspect of this social crisis is the threat of another food and hardship crisis across the world.

More people suffering from hunger or undernutrition and malnutrition across the world

The FAO has estimated that 14.4 million persons would be added to those already suffering from undernutrition in the case of a global economic recession of 2%; they would reach 38.2 million in the case of a 5% recession and up to 80.3 million in the case of a 10% recession – in May 2020, this rate was estimated at 3% for the year 2020. These people will add to the *ca*. 800 million that suffer from hunger across the world, that is one out of nine inhabitants of the Planet. The report on the world's

food situation, published on 12 May 2020, recalled that even before the Covid-19 pandemic the situation was a matter of serious concern. This report, launched in 2013 and carried out by several dozens of actors – nutrition experts, members of international agencies, representatives of the private sector and civic society, donors – monitors the various indicators regarding nutrition. "Malnutrition is still persistent across the world at unacceptable rates. Despite a few improvements in the breastfeeding of newborns, the progress is too slow to achieve the objectives of a satisfactory nutrition" stated the report's authors. Among their worries, one can quote: the persistent rate of 32.8% of women that can bear children but are suffering from anemia; the delayed growth rates of 21.9% of children under five years and the emaciation of 7.3% among them (Gérard, 2020a).

Despite very good crop harvests across many parts of the world, the duration of the lockdown imposed on the populations by the Covid-19 has resulted in "a demand crisis" above all, said Nicolas Bricas, a researcher at the French International Cooperation Centre In Agricultural Research For Development (CIRAD, French acronym). "It does not mean that everything is fine with respect to the offer, but it does not seem that we are facing a global lack of food, nor soaring prices," he added. On his side, Valentin Brochand, who is an advocate of the non-governmental organization *CCFD-Terre solidaire*, made the following precision: "For the moment, it is not an agricultural-production crisis, it is a crisis of accessibility to food, be it physical because the food markets are closed, or because of the lack of resources, i.e. people having not a sufficient income to buy the food they need." Rural malnutrition is more threatening than urban malnutrition. In the very large towns of developing countries, the forced standstill of almost the whole economy, particularly in its informal sectors, makes the situation explosive. For instance, in Dacca, Bangladesh's capital, which has more than 20 million inhabitants, 7 million of them live in slums; and there, hunger is more threatening than the Covid-19. The food stored by the families in the Korail shanty town almost disappeared when the household's income collapsed after the government imposed the lockdown on 26 March 2020. The workers indeed lost their jobs almost immediately in the low-cost textile industry or when employed as servants or rickshaw drivers. Deprived of any savings, a lot of families had to feed themselves only once a day so as to keep part of their paltry food reserves (Gérard, 2020a).

In the long term, the impact of this malnutrition situation is scaring. "Every decrease of one percent of the gross domestic product (GDP) results in an increase of 700,000 children having a delayed growth rate. And these children will have an offspring suffering from the same disability," explained Gerda Verburg, a former agriculture minister of the Netherlands and coordinator of a movement aimed at strengthening the emphasis to be laid on nutrition (SUN), which includes dozens of States, representatives of civic society, private sector and donors. But hunger will not be the single end result of the pandemic; economic recession will affect the diets of the most vulnerable people, with a likelihood of the increase in pathologies associated with under- and malnutrition. "Human populations will purchase more affordable and available foodstuffs, but which are less nutritious," explained V. Brochard. "We run the high risk of seeing high rates of undernutrition as well as of vitamin and micronutrient deficiencies," he added (Gérard, 2020a).

Let us take the case of India, a country of *ca*. 1.3 billion people, which has been going through a major economic crisis before the Covid-19. The annual economic growth rate fell down to less than 5% compared with almost 9% two years earlier (2017). The rate of unemployment was very high, the consumption rate was decreasing and a bank (financial) crisis was looming on the horizon. In other words, all economic indicators were quite bleak (Landrin, 2020b). The Covid-19 and the lockdown of the population imposed by the government of Prime Minister Narendra Modi on 24 March 2020 have upheaved the food-supply chain as well as the access to food of thousands of Indians. Some experts are afraid of the return of hunger in this very large country. In particular, the situation of migrant workers is very worrying, because these millions of poor, locked in cities, without income due to the close down of their factories, have no official residence in these towns and therefore no rationing card that would enable them to receive the governmental aid, in kind or in cash. Nevertheless, "we are not in a situation of an offer crisis because the harvests of *rabi* – crops sown in winter and harvested in spring – have been rather abundant and they will increase the already bounty grain stocks. But we are facing a crisis regarding the access to food," explained Bruno Dorin, an economist working at the New Delhi human-sciences centre of the French CIRAD (Landrin 2020a).

The agricultural sector still employs 50% of the whole Indian population, i.e. a little more than 650 million people, but it contributes to only 14% of the GDP. The great majority of Indian farmers and agricultural workers are extremely poor. In the 1970s, the "green revolution" aimed to increase agricultural productivity in order to meet the needs of a growing population and thus to move away from the likelihood of famines. This revolution indeed has enabled India to become food self-sufficient and thus to put an end to the dependence on the United States. From the economic viewpoint, the production model that has been developed consisted of a production subsidized by the state and of the purchase of farmers' harvests through public calls with a view to distributing the foodstuffs to the poor. Thus 75% of the Indian population had access to a quota of basic products (Landrin, 2020a).

This green revolution has promoted monoculture, for instance in the Punjab which became the wheat and rice granary of India. Using higher yielding crop varieties, that need fertilizers, water and pesticides, India has in 20 years doubled its grain production. Punjab, for instance, has received annual subsidies amounting to US$1 billion or €930 million aimed at paying the supply of electricity, an important input to irrigation, as well as a similar amount of money to buy fertilizer inputs. In terms of fertilizers, India has become the world's third-biggest consumer, behind the United States and China. Because of soil erosion, the exhaustion and pollution of water tables, and the drastic decrease in biodiversity, many experts think that this green revolution resulted in an environmental (ecological) disaster. Maybe such judgment is controversial. Although the defects of this green revolution are recognized, it nevertheless fostered the undeniable improvement in agricultural productivity and food supply (Landrin, 2020a).

From the nutritional viewpoint, Indian diets have become unbalanced, i.e. too rich in carbohydrates, but poor in vitamins, micronutrients, fatty acids and proteins. The proportion of legumes – lentils, chickpeas – in the daily diet has been halved,

while these foodstuffs bring in much needed proteins, especially for the numerous vegetarian Indians. In fact, the majority of the population consumes low-cost grains – rice and wheat; fruit and vegetables are too expensive for the poor. The chronic pathologies related to an unbalanced diet can be illustrated by the following figures: 9.1% of Indian men and 8.3% of women are diabetics; 20.8% of children under five years are emaciated – this rate is the highest in the world –, while the percentage of overweight or obese Indians is growing. In 2019, the figures concerning the "hunger index" have ranked India at the 102nd position among the 117 countries reviewed in that respect. Undernutrition still persists, as well as extreme rural poverty that is being worsened by climate change and erratic weather events – floods, hurricanes and recurrent droughts. It is estimated that *ca*. 190 million Indians are suffering from hunger. Since the 2010s, India has been going through another agrarian crisis, and farmers are frequently claiming the cancellation of their debts. As explained by B. Dorin, "in India the difference between household incomes has increased. As there is no sufficient employment in other sectors of the Indian economy, agricultural population has increased instead of decreasing, the farm acreage has shrunk, and despite the high crop yields achieved thanks to the abundant supply of subsidized inputs, farmers are increasingly indebted and many commit suicide." To overcome the Covid-19 pandemic, many experts and charity associations have requested the Indian government to release part of the governmental grain reserves in order to grant universal food aid during the next six months (until the end of 2020). Paradoxically, "hunger is threatening millions of Indians," at a time when the governmental food reserves have never been so plentiful (Landrin, 2020a). On 12 May 2020, Prime Minister Narendra Modi announced in a television speech the launching of a €246.8 billion plan – 10% of the GDP – to boost the national economy, shattered by the pandemic (Landrin, 2020b).

United States: fighting the Covid-19 erratically and overwhelmed by the new poor

While the death toll due to Covid-19 reached more than 200,000 by the end of September 2020 (see Epilogue, p. 405), the erratic struggle against the disease by the world's most powerful country has revealed the profound dysfunctioning of the United States' economic, social and political system. When Donald Trump, President of the United States, delivered his third speech on the State of the Union on 4 February 2020, he did not even mention the occurrence of the pandemic. He emphasized that the country had the longest cycle of economic growth – for 128 months without any interruption –, that the unemployment rate was at its lowest level in a lapse of 50 years, and that the stock exchange – Wall Street – had reached historic summits. However, the president could not ignore that two weeks earlier, a 35-year-old man from the Washington State Snohomish county who came back from Wuhan a few days earlier, had been tested positive for the coronavirus SARS-Cov-2. That was the first confirmed case in the United States. The president's attention was focused on its possible reelection in November 2020. In fact, this first unprecedented contamination underlined the glaring deficiencies of an economic system characterized by profound inequities and it revealed a sanitary and social pattern that was poorly adapted to successfully control the pandemic. On 13 March 2020, the state of sanitary emergency has been proclaimed. In New York City, Andrew Como, the State of New York's

governor and Bill de Blasio, the mayor of the City, had to decide whether to close down the schools or not. The hesitation of both politicians was not related to sanitary or educational factors, but to the likelihood of social risks. In a city where live the highest number of billionaires in the world, out of the million pupils that attend New York's 1,700 public schools, 750,000 belonged to households living under the threshold of poverty and one pupil out of ten had not a permanent home. For most of them, the school was the space where they can have one full meal a day and where the social services could somewhat help their families. Both A. Como and B. de Blasio were very conscious of the stakes involved, they resisted until the last moment before they had to close down the schools due to the emergency of the sanitary situation (Kauffmann and Lauer, 2020).

In New York City again, the Bronx and the Queens – the poorest districts of the city – had twice the contaminated people than Manhattan where the population density is the highest in the city. In the latter, indeed, the ratio is one to forty between the richest 20% people and the poorest 20% – a situation similar to that prevailing in Namibia or Sierra Leone. Manhattan's well-off people could escape the city and move to the Hamptons beaches or the greenery of the Hudson Valley. In Michigan State, 40% of those who died from the Covid-19 were African Americans, while the latter make up only 14% of the State's total population. But it was the health-care system vulnerability that led to these disastrous implications. "In international rankings about the capacity of a country to control a pandemic, the United States were among the most able ones – with Germany for instance – in terms of strategic reserves, the industrial capacity of producing treatments and supplying the needed equipment and the quality of research laboratories and scientists," stressed Thomas Philippon, an economist at New York University. And he explained that "the propagation of the SARS-Cov-2 highlighted a very heavy failure for the country and that D. Trump's administration was to a large extent responsible for that failure." In spite of several alerts by the intelligence services and of the two or three weeks that would have enabled the United States to adequatly face the pandemic, compared with Europe, the country was snatched by the outbreaks. New York State reported 1,300 deaths due to the coronavirus per million inhabitants – a figure that was three times higher than that of Italy, the disease epicenter in Europe. That deplorable result underlined once again the weaknesses of the United States' health-care system (Kauffmann and Lauer, 2020).

These weaknesses were not new. It is a costly system – an average of US$11,000 per inhabitant, or 18% of the GDP at the end of the second decade of the 21st century – and with a poor efficiency. For instance, life expectancy that has been decreasing since 2015, because, among other reasons, of the overuse of opioids which has wrecked havoc during the last decade, is much lower than the average of most OECD (Organization of Economic and Cooperation Development) countries. Also the rates of comorbidities that worsen the prognosis of Covid-19 are among the highest in the world: 40% of Americans are obese, one out of these suffers from diabetes and one out of two suffers from cardiovascular diseases. Such a sanitary situation is worsened by the fact that the United States are among the very few developed countries that was not imposing on the companies a health insurance for their employees. Since his election in 2016 as President of the United States, Donald Trump has tried to

progressively destroy the Obama care – the insurance system set up and implemented by his predecessor, Barack Obama. The budgets of the federal health agencies were slashed and the end result was that when the pandemic outbreak occurred, 30 million people living in the country had no health-care insurance. Such situation worsened very rapidly when the unemployment rate soared, because one American out of two has a health insurance linked to his/her job. According to Gabriel Zucman, an economist and professor at the University of California, Berkeley, "this crisis very clearly demonstrates the limitations and absurdity of the model, that is supported by the strong lobbying of the private insurance companies." Also, the economic implications of the sanitary crisis worsen the structural unbalance of the hospital system, consisting mainly of lucrative establishments that welcome patients having an insurance subscribed to private companies. Due to the rise of employment rate these insured people were less numerous, while at the same time the public health-care sector could not cope with a lot of patients deprived of their insurance (Kauffmann and Lauer, 2020).

The erratic management of the Covid-19 pandemic by the White House could also be related to the President's skepticism regarding science. During his interviews with journalists or in his speeches on the subject, he used to change his convictions: from denying the importance of the pandemic in the United States to boasting about his administration's reactive and appropriate action, thereafter adopting a belligerent mood. He never gave the impression that he was mastering the situation and he decided to appoint his son-in-law, Jared Kushner, as the coordinator of the Covid-19 scheme aimed at controlling the disease. However, according to many experts, the erratic management of the crisis was not confined to the White House. The division of the American nation played a key role: there is a deep polarization of the American society; after the outstanding unity that occurred after the terrorist attacks of September 11, 2001, there is now a societal rift on the issue of how the get out of the lockdown and on the underlying debate regarding the supremacy of economy versus health, or regarding the superiority of individual freedom versus collective security. In April 2020, there have been protests such as "Free Michigan", "Free Virginia" or "Free Minnesota", by those who were against the measures of lockdown decided by the States' governors. On 30 April 2020, in East Lansing – Michigan's capital – these protestors bearing arms on them invaded the building of the local parliament in order to express their opposition to the lockdown imposed by the State's governor at that time, Gretchen Whitmer. It is nevertheless true that this societal rift did not appear with the Covid-19 pandemic. The outstanding unity that was obvious after September 11 was to a large extent shattered in the aftermath of the Irak war – the country was invaded by the American forces in 2009 – and also during the 2008 financial crisis – in this case, the bankers, to a large majority, recovered quite well, while the American middle class deeply suffered. All these factors have increased the division and distrust among American people (Kauffmann and Lauer, 2020).

In the magazine, *The Atlantic*, Francis Fukuyama predicted that, in the struggle against the Covid-19, the trust in the leadership and the competence of the latter will be the keys of success; and not the divide between democracies and autocracies. Francis Fukuyama (1992), a former deputy-director of the United States State Department's Policy Planning Staff, and thereafter a resident consultant at the RAND Corporation in

Washington, D.C., has published *The End of History and the Last Man*, an exciting and profound inquiry that suggests there are two powerful forces at work in human history. F. Fukuyama calls one "the logic of modern science" and the other "the struggle for recognition". The first drives men to fulfill an ever-expanding horizon of desires through a rational economic process; the second, "the struggle for recognition", is, in Fukuyama's (and Hegel's) view, nothing less than the very "motor of history." It is Fukuyama's brilliantly argued theme that, over time, the economic logic of modern science together with the "struggle for recognition" lead to the eventual collapse of tyrannies, as we have witnessed on both the left and right … The great question then becomes: can liberty and equality, both political and economic – the state of affairs at the presumed "end of history" – produce a stable society in which man may be said to be, at last, completely satisfied? Or will the spiritual condition of this "last man" in history, deprived of outlets for his striving for mastery, inevitably lead him to plunge himself and the world back into the chaos and bloodshed of history? Fukuyama's contemporary consideration of this ultimate question is both a fascinating education in the philosophy of history and a thought-provoking inquiry into the deepest issues of human society and destiny. Among the praise for F. Fukuyama's book, one could quote Allan Bloom: "Fukuyama tells us where we were, where we are, and most important, speculates about where we will likely be – with clarity and an astonishing sweep of reflection and imagination. His command of political philosophy and political facts takes us beyond the daily newspapers to a grasp of the meaning of our situation."

Coming back to the Covid-19 pandemic, in the absence of a trustworthy leadership at the federal level, the States were trying to protect against each other in order to slow down the dissemination of the virus. For instance, Alaska and Hawaii have decided to isolate (quarantine) travelers coming from the continent. Citizens rely on their State's governor whom they trust more than the federal system. California, whose governor Gavin Newson at that time was the first to decide to lockdown the whole population of the State, was therefore compared to a nation-State. G. Newson and A. Como (New York State's governor), both Democrats, have become national icons, due to their more rational way to deal with the crisis. By the end of March 2020, 14 States ordered the lockdown of their populations – i.e. the majority of the United States population (Kauffmann and Lauer, 2020).

As mentioned by Martha Ross and Nicole Bateman, researchers at the Brookings Institution, Washington, D.C., 53 million Americans were earning "low wages" – i.e. an average hour salary of US$10.22. "The last economic growth cycle has been very poor in terms of income increase and creation of jobs," explained Véronique Riches-Flores, an economist working on United States' economy. Thus, when stock-exchange rates were hitting record levels, the average hour salary calculated with inflation adjustment has not increased since 1973, while the purchasing power of the minimum federal salary has been decreasing since 1968. Before the Covid-19 crisis, 23 million Americans aged between 25 and 54 years were unemployed. Most of them were not recorded in the statistics of unemployment, because they were not encouraged to seek a job or because of health reasons. If the weaknesses of the American system or model were highlighted by the Covid-19 pandemic, it is also true that in the past the United States have shown their capacity to recover and overcome their difficulties; they have in this regard several advantages: the US dollar, which is still the main international

currency, the military might as well as a renowned innovation capacity in science and technology (Kauffmann and Lauer, 2020).

It is nevertheless true that the soaring rates of unemployment have increased the number of the new poor. In New York City, for instance, *ca*. 9,000 employees of the City Hall's staff have been delivering every day 600,000 meals and 250,000 breakfasts in *ca*. 2,000 establishments. This food-aid system was set up after the schools have been closed down and a meal was provided to, and taken away by, any child or teenager under 18 years, between 7h30 am and 1h30 pm. One week later, by the end of March 2020, food-aid delivery was set up in 450 targeted schools, ubicated in the districts having a strong demand of food aid and where are living lower-income households. The City Hall's services decided to add a dinner to the meals served, and to offer the choice between halal, kosher or vegetarian menus; the meals could be taken away by the children themselves or by their parents. This food-aid plan was unprecedented in the City and the State of New York. Andrew Como called on the philanthropic associations to join the food-aid plan (Lesnes, 2020).

According to New York State's governor, out of the 8.5 million inhabitants living in New York, 1.1 million were considered food insecure; to those should be added at least 500,000 persons who had lost their job. Before the Covid-19 crisis, the United States Department of Agriculture (USDA) has estimated that 11.1% of households were in a situation of food insecurity; 6.8% had a poor diet and they must make savings on their food purchases in order to pay their rent or health-care bills; and 4.3% were suffering from major food insecurity – another name for hunger. Food insecurity has been estimated at 28% for lonely women raising their children, 21% for the African Americans and 16% for Hispanics. Such rate of food insecurity that soared up to 15% after the 2008 financial crisis, had come back to its level before the crisis. Soup kitchens that became common during the 1930s had in fact existed since the 1870s, when the United States acknowledged an economic recession; at that time therefore the first charity organizations were created. By the end of the 1960s, food banks have been set up and they came back again during the 2008 financial crisis. In 2020, since mid-March when more than 30 million Americans have lost their job, people were queuing up again in order to receive basic food ingredients: for instance, hundreds of families have been queuing up for the weekly distribution of food in Pittsburg, a former steel-industry town in Pennsylvania; in Sunrise, Florida, cars were filing up for the same reason; in San Antonio, Texas, 6,000 motor-cars have been waiting on a parking lot to get food (Leparmentier, 2020b).

The federal administration had devoted US$3 billion to buying food from American farmers and agrifood companies with a view to directly distributing it to food banks, local charity and religious associations as well as to non-profit organizations that help Americans in need. An editorial in *The New York Times*, co-signed by Beto O'Rourke, a former politician who unsuccessfully tried to be the Democrat challenger of D. Trump in 2020, strongly recommended the use of the former food stamps that helped households to buy their food in the shops of their choice. Such recommendation will help the smaller shops to remain active and to serve Americans in need locally. But the federal administration was reluctant to adopt such measure, because it refused to create state allowances (Leparmentier, 2020b).

Europe and its new poor

By the end of April 2020, a joint appeal by the European Federation of Food Banks, Feeding America and the Global FoodBanking Network stressed their involvement in a "massive struggle" aimed at "feeding an increasing number of households and persons" –a very complicated situation due to "the frequent interruptions of transport means and by the quarantine measures." Jacques Vandenshrick, president of the European Federation of Food Banks – a network of food banks in 29 European countries – made the following statements: "Social crisis is before us and we know, from experience, that it lasts longer… Before the Covid-19 crisis, 30 million people were already poor in Europe, and one thought that this figure will fall down to 20 million in 2020." For instance, in Madrid and Barcelona, food requests have trebled and, according to Caritas Madrid, 40% of these requests came from persons who never before relied on this kind of assistance. Maria Walsh, the Irish member of the European Parliament, made the following comment: "According to the last estimates, in April 2020, the unemployment rate in Ireland soared from 5.4% to 28%; whereas Agnes Jongerius, a Dutch member of the European Parliament, stated: "Even though the Netherlands never decided to set up a complete lockdown of their population, as did Italy and Spain, the economy has slowed down considerably; an increasing number of people had to rely on food banks, and this is just the beginning; in cities like Amsterdam this increase has been already estimated at 30%." After a month of lockdown, the Food Foundation of the United Kingdom has published the results of a study carried out during the period 24-29 April 2020: 5 million British people having children under the age of 18 were in a situation of food insecurity, i.e. twofold the level set up by the Food Standards Agency in 2018. The study also estimated that out of the 621,000 children benefiting from a free breakfast before the Covid-19 crisis, only 136,000 could benefit from a substitute (Mandraud, 2020).

"Before the epidemic, the European budget was already providing food assistance to *ca*. 13 million people, thanks to the European Fund for Helping the Most Destitute," explained Jaume Duch, the European Parliament spokesperson. The amounts provided to the States by this fund, created in 2014 and having an allocation of €3.8 billion, were unanimously considered insufficient. In Italy, according to recent estimates, "we shall be confronted with an increase of *ca*. 4 million people living in extreme poverty," recalled Elisabetta Gualmini, an Italian member of the European Parliament (Mandraud, 2020). The overall conclusion in many European countries is that despite the colossal amounts of money announced by the governments with a view to containing the social and economic implications of the pandemic, the situation is becoming worse in terms of employment, access to food and poverty – these people becoming the European new poor.

For instance, the situation that prevailed in Spain was really dramatic. On Saturday 16 May 2020, in Madrid, in a district situated in the northwest of the city, young people, mothers and senior people were queuing up to receive bags of food ingredients. According to Caritas, a charity association, food requests had trebled in Madrid and 40% of these came from people that never relied on such aid. This was obviously due to the profound economic recession, estimated at -9% in 2020. "In 2008, the

financial crisis was followed by soaring unemployment that resulted in the transfer of many people into the informal economy. Now, we are facing a sanitary crisis, that even paralyzed housekeeping by maids who could not attend their working places as well as the assistance to handicapped people; it also fostered unauthorized market places…" summarized Angel Franco, the spokesperson of the Spanish Federation of Food Banks. "A lot of people found themselves without any income from night to day," he added (Morel, 2020). Before the Covid-19 crisis, and despite the economic recovery, informal or subterranean economy remained important in Spain. According to a 2018 report of the Foundation of Savings Banks (FUNCAS, Spanish acronym), this informal economy would represent 18.5% to 24.5% of Spanish GDP. And, according to some estimates, the number of people working in moonlighting was almost 4 million. On 16 April 2020, Alberto Rodríguez, a member of the Canary Islands Podemos party, part of Spain's governing coalition, stated: "When you have no income, there are two possibilities: one is to rely on the aid of a social, community or family networking, and the other is to become involved in the informal economy. Otherwise, you cannot fill your refrigerator." This deputy was very much in favour of a "minimum income" the Spanish government wanted to establish with a view to struggling against the urgent social crisis (Morel, 2020).

Since the 17th of March 2020, the Spanish government, a leftist coalition led by the socialist Pedro Sanchez, was trying to set up a "social shield" aimed at reducing the social and economic impact of the Covid-19 pandemic and at avoiding the increase in extreme poverty. "Ten years after the last crisis – the 2008 financial crisis – we are not going to repeat the same errors," has promised P. Sanchez on Saturday 23 May 2020 when he announced the creation of a minimal vital income (IMV, Spanish acronym for *ingreso minimal vital*). The decision to set up such an allowance has been accelerated by the urgent need to somewhat buffer the social cost of the Covid-19 pandemic. This allowance was calculated on the basis of the actual incomes and available resources and it was associated with the active search for a job; it could benefit almost 850,000 vulnerable families, i.e. 2.3 million people, and it would cost €3 billion to the state's coffers. The range of this allowance was between €461 for a single person and €1,100 for a family supporting more than two children. The overall objective of this IMV was to draw 75% of the 600,000 households out of extreme poverty (Morel, 2020). Also since the 17th of March 2020, when the state of sanitary emergency was announced, many kinds of assistance estimated at €30 billion have been granted. A partial-unemployment pattern was helping 3.4 million people because of an "imperative reason": employees received 70% of their wages, paid by the social security, while the owners of the companies or businesses did not pay the social taxes if they committed themselves to maintain the jobs for six months after the end of the state of sanitary emergency. Despite this welcomed measure, non-governmental organizations and food banks have been overwhelmed, long queues have been formed in front of the popular soups, while local associations strived to respond to the requests for basic food needs. "We have increased our assistance by 94% between 14 April and May 2020. About 90% of this assistance tries to meet basic needs, including 22% for the payments of rents," summarized Maria Blanca of the association Caritas in Madrid (Morel, 2020).

In France, several initiatives have been trying to help the people in need. Many associations delivered food aid to the new poor affected by the Covid-19 crisis; the latter has worsened their condition and they suddenly became the new poor. There is in France a long tradition of effective assistance, but this time all endeavours had to become more frequent and efficient. The large food distributors also joined the efforts made and supplied all kinds of food ingredients. In addition, an initiative that is worth mentioning is the creation of participative kitchen gardens or vegetable plots that supply organic vegetables to those hit by the Covid-19. Thus six plots with an acreage of 150 m^2 to 1,400 m^2 have been selected in six communes ubicated in the centrewest of France (Deux-Sèvres department). In September 2020, 3 to 4 tons of potatoes were harvested, as well as leeks, cabbages, white beans and pumpkins, that were delivered to local food-aid associations. The project was named *The bocage* – an agroecosystem consisting of small agricultural plots separated by many hedges that increase biodiversity – by environment activists in April 2020. They were very much concerned about the negative impact on the most vulnerable populations due to the abrupt standstill of economic activities. In that region where exists a network of small and very small-sized companies, mainly working in craftsmanship and agrifood industry, "people have low wages, partial unemployment has hurt their standard of living, while the closing down of school restaurants has incremented their budget devoted to food purchase; they are therefore living in difficult conditions and the situation is likely to worsen," explains Claire Chevalier, one of the key actors of the project (Potet, 2020).

"*The bocage is on a top form*" has been launched through video-lecturing and phone conversations and with some emergency, because potato planting could not be carried out after May 2020. In the local newspapers and social networks, calls have been made in order to attract human power. *Ca*. 50 persons joined the leaders of the movement consisting mainly of agriculture professionals – livestock breeders, fruit producers, retired farmers and teachers in agricultural high schools. Finally, on 16 May 2020, planting has begun. In addition to their struggle against the loss of agriculture acreage due to urbanization sprawling, the members of the movement aimed to create the conditions of vegetable cultivation in everyone of their communes that could supply the schools and retirement homes. They are also making advocacy for food crops and "social food security" – a concept supported by many national environmental (ecological) associations and aiming to provide a monthly allowance for purchasing fresh produce, via organic agriculture techniques, circular economy and care for animal well-being. Marie Gazeau, an owner of a fruit-tree nursery, wondered whether "the organic potatoes grown by this solidarity consortium would suit the culinary habits of persons who generally receive food aid in the form of prepared meals and ultra-processed foodstuffs. Obviously, this is not a win-win situation." This issue is also debated by another association called *Epicerie solidaire de Cerizay* (Cooperative Grocery of Cerizay, a town ubicated in the Deux-Sèvres department, centrewest of France). The members of this association belong to more than 200 families living in difficult conditions (unemployed persons, poor workers, monoparental families, isolated senior people). Since 2013, organic vegetables and eggs have been supplied to these people in order to complement their current food ingredients – pasta, prepared meals,

preserves or canned foodstuffs. Cooking workshops are also organized with a view to promoting homemade food. This association will contribute to distributing part of *The Bocage* harvests to a higher number of beneficiaries, according to both associations' hopes (Potet, 2020).

The prospects

On 13 July 2020, the last report on *The Situation of Food Security and Nutrition in the World 2020*, jointly published by the FAO, WHO, WFP, UNICEF and IFAD, and called the SOFI report (see p. 34), provided the last data on starvation across the world. The overall conclusion drawn from these data is that starvation is globally increasing, although the planet produces enough food. Before the Covid-19 pandemic worsened the overall global food security, it was estimated that 690 million people or 8.9% of the global population were undernourished, i.e. having not sufficient food to supply the energy for a healthy, active and normal life; and this according to the data gathered in 2019. This figure was lower than the one currently admitted: 820 million or more (see below). This difference was due to the use of a more precise methodology that enabled all the United Nations agencies to make important statistical corrections. Thus, the data gathered in 13 countries, including China – one-fifth of the global population – have been revised starting from the year 2000. These corrections have resulted in the decrease of the undernutrition level, but they did not change the overall trend. The new data confirm the slow but continuous global growth of hunger since 2014: in five years, 60 million people suffering from starvation have been added to the total (Gérard, 2020b).

And the forecasts are not good: while excluding the impact of the 2020 pandemic and economic crisis, the United Nations have predicted that in 2030 *ca*. 840 million people would be suffering from starvation or hunger across the world, if the present trend continues. This figure would even be worse because of the impact of the Covid-19 pandemic: in 2020, between 83 million and 132 million people should be added to the global figure. The majority of undernourished people live in Asia (381 million), but it is in sub-Saharan Africa that the fastest growth-rate of hunger has been recorded: 19,1% of the African population are suffering from hunger (250 million people), compared with 17,6% in 2014. In West Africa, the Sahelian region runs a great risk of starvation. For about ten years, this region has been suffering from the deepest food crisis in the world. But in 2020 it has become an emergency situation. In addition to violence and fight between ethnic communities in Mali and the north of Burkina Faso, global warming is accelerating in that zone – 1.5 times more than the global average – and the Covid-19 had the worst impact. Some humanitarian-aid experts have called it the "virus of hunger". "The World Food Programme (WFP) has estimated that 3.9 million people of the Central Sahelian region will suffer from food insecurity in 2019-2020. But now we evaluate them at 5 million," said Alexandra Lamarche of the NGO Refugees International (Maillard, 2020).

Central America is another region that worries the UN agencies: 9.3% of the population is undernourished, compared with 7.9% in 2015. If were are focusing on the broader concept of food insecurity, which deals with the long-term incapacity to have access to a healthy and balanced diet, the United Nations estimated that 2 billion people or more than one-fourth of the global population were affected in 2019. And several indicators are worrying international experts: emaciation affects 6.9% of children under five years, i.e. much more than the objective of less than 5% for 2025. Emaciation is characterized by a lower weight of the child with respect to its size; it is the sign of a lack of food energy input and/or nutrient deficiencies and *ca*. 340 million children are affected. On the other hand, almost not a single region of the world is on the right track to achieving the objectives of infants' overweight – that is affecting 5.6% of children across the world – whereas adult obesity is increasing worldwide, from 11.8% in 2012 up to 13.1% in 2016 (Gérard, 2020b)

One of the new significant contributions of the last SOFI report is about the financial cost of a healthy and diversified food intake. The latter should supply the needed macronutrients (proteins, fats and fibers) and micronutrients (vitamins and minerals) at every stage of life – age, physical activity and individual physiology. But it is out of reach for a larger proportion of humankind. The United Nations agencies have calculated that, on the basis of an equivalent calorie input, healthy and diversified diets were on average 60% more costly than a diet which supplies the main nutrients, but without a diversity of food, and were fivefold more costly than starchy of feculent-based diets. Thus, the cost of a healthy diet is far above the international poverty threshold: US$1.90 or €1.7 per person and per day (Gérard, 2020b).

In addition to the high cost of healthy diets, the SOFI report also gives indications on the unequal availability of each category of foodstuffs. For instance, the report shows that only in Asia and in the middle- or high-income countries, fruit and vegetables availability reaches the minimal recommendations, i.e. 400 g per person and per day. Therefore, the UN agencies recommend the revision of the whole system of production and distribution of food. And this recommendation seems even more relevant when one considers the impact of food on health and environment and their respective costs. The SOFI report has calculated that the cost of the food impact on health would reach US$1,300 billion in 2030, while the impact on the climate – emissions of greenhouse-effect gases – would have a cost estimated at US$1,700 billion also in 2030. These costs could be drastically reduced through the adoption of healthy diets: by 97% in the case of health care and by 41% to 74% in the case of climate-change mitigation. This calculation is not surprising, but it was the first time that "it showed that is much more profitable for the global humankind to change our food systems in order to invest in healthy diets," explained Valentin Brochard of the NGO CCFD-Terre solidaire. Maximo Torero, FAO chief economist, added: "If we could supply a balanced and diversified food to the populations through acting on the commercial policies as well as on the productivity, and subsidizing the healthiest products … we should be able not only to decrease hunger, but also to provide benefits for health and environment" (Gérard, 2020b).

Overhaul of our food systems

Just before the publication of the SOFI report, on 9 June 2020, the United Nations Secretary-General, Antonio Guterres, stated: "Our food systems do not work and the Covid-19 pandemic worsens the situation." He therefore strengthened some of the conclusions of the SOFI report regarding the "food systems" that will be the focus of a UN summit in 2021. This concept has been studied by some researchers at Johns Hopkins University (JHU), Baltimore, Maryland, USA. They have launched a kind of "dashboard of food systems," which is in fact a website devoted to all food statistics, taken from different databases such as those of FAO, UNICEF and private institutions (e.g. Euromonitor). More than 160 indicators have been gathered so as to visualize, in each country, the informations on agricultural production, the use of pesticides, the transport and distribution networks, the proportion of food purchases in the households' budget, or the data on nutrition and health. Jessica Fanzo, professor at JHU, who has lead the team of researchers that conceived this tool, mentioned that "the overall objective was to visually gather all these data in a single site, rather than to have to navigate through *ca*. forty different sites." Johns Hopkins University that is recognized for its valuable work on the follow-up of the Covid-19 pandemic, shows again its statistical know-how: "Food systems had their problems before the Covid-19, regarding their functioning, inequities and capacity to supply a healthy food. The pandemic has sharply emphasized these problems," explained J. Fanzo. The tool developed by JHU helps to understand the interdependence between the health of the planet, human health and economic health. "The challenge is not only to produce food, but also to understand how we transform, distribute and consume it, as well as how we waste it. Today, all the revelant data are not available," mentioned Nicolas Bricas, who works at the Centre for International Cooperation in Agricultural Research for Development (CIRAD, French acronym), but has not participated in the design of the "dashboard" (Gérard, 2020c).

Anna Lartey, FAO nutrition director, explained that "the planet produces enough food for its inhabitants, but nevertheless 690 million people suffer from undernutrition and 2 billion people have not a good-quality diet. We should focus on the mechanisms and institutions involved." She thinks that the indications of the "dashboard" are numerous. For instance, "We know that obesity is increasing in all countries. To what kind of food the population has access? What is the proportion of fruit and vegetables in the diet? What is the proportion of the household's budget devoted to food purchases? All this information can help in making the good decisions." Nicolas Bricas underlined that in the overhaul of the food systems, "We are not starting from scratch. For many years, there have been in several locations new approaches to producing, distributing and consuming in a distinct way." But in order to speed up the necessary change, these local initiatives need political legitimacy to which could contribute for instance the statistical tools developed by JHU (Gérard, 2020c).

Achieving food resilience: field approaches

On 15 July 2020, France's Prime Minister, Jean Castex, has emphasized in his speech of general policy at the French National Assembly, the need "to produce homegrown quality food that is affordable in all the towns and villages of France." He also emphasized the need to develop "short distribution networks" (circular economy). In fact, several experiments are being tested in the field. The approach of some of these, which aim to reach a high level of food autonomy or "resilience," has been strengthened by the Covid-19 pandemic. For instance, the young French NGO called *Les Greniers d'abondance* (The Abundance Granaries), founded in 2018, has granted local food resilience a very high priority. One of the two founders of the association, Arthur Grimonpont, explained: "We have started from the fact that present policies could not avoid the disruptive events or phenomena regarding climate, energy and environment. We must therefore anticipate and adapt our food systems, that have a vital function." "The goal is to achieve a certain level of autonomy in the French territories, so as to provide a basic food security," added Félix Lallemand, his co-founder. The association tries to highlight the vulnerabilities of a global food system: climate change, collapse of biodiversity, soil degradation, exhaustion of energy and mining resources, sanitary crises, etc. And it is at the local level that one should emphasize the food security issue, the association thinks (Bolis, 2020).

The issue of the food system resilience, although being still an emerging concept, was nevertheless one of the objectives of the Milan Pact signed by about one hundred of big towns, including eight in France, that were committed to a sustainable food policy. In order to achieve more resilience, it seems necessary to think big at all levels of the food-production chain. "The most crucial dependence issue is energy: oil (totally imported in the case of France) is the blood of our food system," explained Arthur Grimonpont. Several solutions have been suggested: local production of biofuels or use of draught animals, relocation of fertilizer production, as well as seed production and agricultural-machines manufacture. Water is also becoming a scare resource, due to recurrent droughts. In France, food resilience is being developed beyond the city's borders and thanks to an alliance between urban dwellers and rural inhabitants (Bolis, 2020).

In Paris, many urban-agriculture initiatives exist, but the supply of food for Paris dwellers cannot be conceived in such a reduced perimeter. "To conceive food autonomy at the scale of a town is meaningless; the existence of towns depends on the capacity to produce more food elsewhere so as to feed the urban dwellers," explained Sabine Bognon, a lecturer at the Ecology and Conservation Sciences Centre. At the level of the rural environment, the resilience is not that obvious. "The rural environment is generally considered as the main agricultural-production zone or acreage," observed Claire Delfosse, a geographer. "There are, however, problems relating to mobility, access to commercial areas ... And the territories are most often specialized in terms of production, with considerable imports and exports." Therefore, the issue of resilience cannot be self-contained in an autonomy of towns or rural territories, and it cannot be by all means a turning in on oneself." The system should be rebalanced toward more proximity, but the issue is not to move toward a 100% of local production! "Because vulnerability could become worse, for instance if floods or an epidemic occur and

could wreak havoc on the crops of a region," stated Yuna Chiffoleau, a researcher at the National Agricultural, Food and Environmental Research Institute (formerly INRA, French acronym for *Institut national de la recherche agronomique*, National Agricultural Research Institute). "There is a need, for instance, to build partnerships, e.g. in the supply of meat between Paris and a nearby department. In other words, one moves from imposed dependence to a mastered interdependence" (Bolis, 2020).

Malnutrition: the hidden hunger

Governments across the world are paying increasing attention to nutrition. In this regard, The World Bank had published a book titled: *Repositioning Nutrition as Central to Development - A Strategy for Large-Scale Action* (2006, re-edited every year since then). Even where there is enough food, people do not seem to be healthier. On the top of *ca*. 1.6 billion without enough calories in 2017, another 1 million were malnourished in the sense that they lacked micronutrients (this is often called "hidden hunger"). Furthermore, *ca*. 1 billion were malnourished, i.e. eating too much and being obese or overweight. Famine symptoms are easy to spot, so are the disastrous effects of obesity. By contrast, the ravages of inadequate nutrition are veiled but not less dreadful. Vitamin as well as other micronutrient (e.g. iron, zinc) deficiencies kill many children, pregnant women and cause mental impairments in newborns (cf. Sasson, 2019).

In the report published by FAO on 11 September 2018, it was highlighted that climate change played an important role in the increase in starving and undernourished people across the world in 2017 compared with 2016. And also that the limited or very limited access to food, and in particular to healthy foodstuffs, contributes to denutrition as well as to overweight and obesity. While the number of children, under 5 years, with an excess weight remains almost stable (38 millions), i.e. one child out of five, obesity in adults is worsening (one out of eight is affected across the world, i.e. 672 million people). Once again, it was mentioned that the risk of food insecurity and malnutrition increases among the populations' poorest categories and that their food resources are particularly vulnerable to climate variability (FAO et al., 2018).

Regarding the global obesity epidemic in adults, the body-mass index (BMI) has increased steadily in most countries in parallel with a rise in the proportion of the population who live in cities. This has led to the view that urbanization its one of the most important drivers of the global rise in obesity. However, Majid Ezzati and his team of researchers at Imperial College, London, have shown that this is not necessarily true (Bixby et al. and Ezzati, 2019). They have used 2,009 population-based studies, with measurements of height and weight in more than 112 million adults, to report national, regional and global trends in mean BMI segregated by place of residence (rural or urban area) from 1985 to 2017. They showed that, contrary to the dominant paradigm, more than 55% of the global rise in mean BMI from 1985 to 2017 – and more than 80% in some low- and middle-income regions – was due to increases in BMI in rural areas. This large contribution was due to the fact that with the exception of women in sub-Saharan Africa, BMI was increasing at the same rate or faster in rural areas than in cities in low- and middle-income regions. These trends have in turn resulted in a closing – and in some countries reversal – of the gap in BMI between

urban and rural areas in low- and middle-income countries, especially for women. In high-income and industrialized countries, Bixby et al. and Ezzati (2019) noted a persistently higher rural BMI, especially for women. According to the authors there is an urgent need for an integrated approach to rural nutrition that enhances financial and physical access to healthy foodstuffs, to avoid replacing the rural undernutrition disadvantage in poor countries with a more general malnutrition disadvantage that entails excessive consumption of low-quality food. See also the four papers, coordinated by Francesco Branca, WHO director of the nutrition department, published in *The Lancet* on 15 December 2019, and dealing with the "double burden" of malnutrition – overweight and undernutrition (Wells et al. 2019; Nugent et al., 2019; Popkin et al., 2019; Hawkes et al., and Branca, 2019).

It should be mentioned that the NGO Oxfam France made a strong plea to political leaders in order to commit themselves to the eradication of hunger in the world, by focusing on its structural causes. According to Hélène Botreau, in charge of food security at Oxfam France, "There is a need to promote small family agriculture, which can feed humankind, and to guarantee the funding resources for the poorest countries in order to enable them to adapt to climate change" (Barroux, 2018b). To sum up, the most recent data published in *The Situation of Food Security and Nutrition in the World 2019. Safeguarding against Economic Showdowns and Downturns, or SoFI* (FAO et al., 2019), showed that that is 2018, 821.6 million people across the world suffered from undernutrition (i.e. with food consumption that cannot supply the energy intake necessary to a normal, healthy and active life). This figure meant 10.8 % of the global population, compared with 10.6% in 2015 (785.4 million people in the world). The figures were in 2005: 947.2 million people and 14,5% of the global population. The steady growth rate observed since 2015 obviously jeopardizes the sustainable development goal of achieving "zero hunger" by 2030.

According to the same report, food insecurity (i.e. when the access to a healthy, balanced and nutritive diet is not guaranteed) hits more than 2 billion people across the world in 2018: Africa (676.1 million people or 52.3%, compared with 554.1 million and 47.6% in 2014); Asia (1,038.5 million people or 22.8% in 2018, compared with 875.6 million or 20% in 2014); Latin America (187.8 million or 30.9% in 2018 compared with 141.2 million and 24.2% in 2014); North America and Europe (88.7 million or 8% in 2018, compared with 105.2 million or 9.6% in 2014). In 2018, the prevalence of undernutrition (percentage) in the various regions was the following; 19.9% in sub-Saharan Africa, 11.3% in Asia, 6.5% in Latin America and the Caribbean, 6.2% in the Pacific and 2.5% in North America and Europe. In other words, one African out of five persons across the world suffered from undernutrition. A dramatic case was that of Venezuela: undernutrition rose to 21.2% of the population during the period 2016-2018, compared with 3.1% in 2009-2011 (FAO et al., 2019).

Struggle against poverty and malnutrition in Europe

"Poverty is a complex and multidimensional phenomenon," stated Louis Maurin, chairman of the French Observatory for Inequalities (*Observatoire des inégalités*). In Europe, especially in the countries belonging to the Eurozone, poverty is generally

estimated in monetary terms, i.e. it includes the percentage of a country's population who lives with an income of less than 60% of the national average income, e.g. in France in 2018, €1,015 per month for one single person. In this country, the average income is *ca*. €1,692 (50% of the whole population has a higher income and the other 50% has a lower income). In 2016, 13.6% of the French population was living in this state of poverty, according to Eurostat, compared with 11.6% in Finland, 11.9% in Denmark, 16.5% in Germany, 19% in Portugal, 20.6% in Italy, 21.1% in Greece and 22.3% in Spain. In the Eurozone, that average percentage increased from 16.1% in 2007 to 17.4% in 2016 (Charrel, 2018).

But poverty cannot be evaluated only in terms of individual income. It also means a limited access to health care, malnutrition and lack of healthy foodstuffs, bad housing (e.g. in France, 4 million people out of *ca*. 66 million live in these conditions, including 2.8 million of them living in very difficult conditions). In order to assess the different components of poverty, the French National Institute for Statistics and Economic Studies (INSEE, French acronym) adopted the concept of "poverty in living conditions"; it therefore made a census of households facing a number of housing difficulties, payment constraints and debt problems due to very low incomes. The level found by the INSEE was not very far from poverty measured in monetary terms, but it does not exactly concern the same persons. In 2016, the percentages of workers having an income lower than the poverty threshold, were 3.1% in Finland, 5.3% in Denmark, 8% in France, 9.5% in Germany, 10.8% in Portugal, 11.8% in Italy, 13.1% in Spain and 14% in Greece. The average percentage was *ca*. 9.5% in the Eurozone (Charrel, 2018). Poverty in Europe is not of the same magnitude as in developing countries, it has different causes and roots, but it has become over the decades something embedded in these societies. Many programmes or action plans have been therefore designed to struggle against this multidimensional societal issue in the countries of the Eurozone, but also in the industrialized world, e.g. in North America, and more recently in China and other emerging nations.

The case of France

As previously mentioned, poverty affected 13.6% of the French population in 2016 – one of the lowest rates of the countries belonging to the Eurozone. And, contrary to one may think, youth is more affected than older people. In 2015, 17.4% of less than 10-year-old children and 17.7% of teenagers, between 10 years and 19 years of age, were living in a household considered as poor, compared with 6% of 60-year-old people, 1.7% of 70-year-old people and 2.4% of 80-year-old ones (Chemin, 2018).

At the end of the Second World War, old people were the main poor in France. During the following years, these old and poor people have been protected by a generalized pension system, which nowadays make up 14% of the country's gross domestic product (GDP) – one of the highest in the European Union. Poverty was therefore more concentrated among younger people, especially those without qualification and unemployed. Furthermore the profile of the precarious families has changed: the number of monoparental households in precarious conditions was higher than that of families with children. "The proportion of persons of foreign origin with the lowest incomes was higher than formerly," stated Julien Damon, a sociologist and

professor at the Paris Institute of Political Science. Such changes led to the definition of the various causes of poverty in France, as well as of its roots: unemployment, social origin, education' level, in addition to the weight of determinisms. According to the Organisation for Economic and Cooperation Development (OECD), six generations, i.e. 180 years, must elapse to enable the offspring of a family having the lowest income to reach the average one. In other words, "in France, in most cases, one is poor because he or she was born poor," summarized Yannick L'Horty, an economist and professor at the University of Marne-La-Vallée, in the vicinity of Paris (Charrel, 2018).

The recent wave of migrants through the European countries, and even farther towards Canada and the United States, is at the core of serious discrepancies among the leaders of the European countries and also within the United States administration regarding the immigration policy. Countries are closing their borders to this migration wave while trying to make a distinction between migrants hit by political persecution in their own country and seeking asylum – generally they used to be accepted, after checking their situation; migrants leaving their countries torn down by civil wars or ethnic conflicts; and economic migrants who try to find out jobs and decent work. Migrants, when they remain in the countries of their final destination, or leave after some time to other countries which might become their final destination, inflate the lowest-income social categories, or quite often those who have no income – until the social security net offers them some kind of protection. They find themselves in the worst social conditions and often depend on the humanitarian assistance supplied by several NGOs and charity associations. Despite this situation which is exacerbated by the increasing number of conflicts and, consequently, of refugees, despite the impact of climate change which also leads to displaced people seeking a haven outside the zones or regions devastated by droughts, floods, hurricanes and typhoons, there are many examples in Europe as well as in the United States, that show the good integration of migrants to their societies over the years; they can even climb up the social ladder and occupy jobs of high responsibility.

At the end of 19th century, the French Republicans considered that the state had the duty to help poor people. They highlighted the principle which was part of the 1791 Constitution and which stressed that the assistance to be delivered to the poor was among "the most sacred duties of the nation." At that time, France, contrary to Germany, had not yet set up a system of social assistance. Therefore, in 1893, and in order to avoid that poverty alleviation depended only on charitable bodies and Churches, the Republicans proclaimed the principle of national solidarity. The 1893 law established that ill people without resources could have access to free health care. In 1904, another law aimed to protect abandoned children, and in 1905 another law dealt with the assistance to be delivered to seniors, handicapped and non-curable-diseased people. This so-called "assistance policy" – that was the phrase used at that time – was a compromise between the liberal philosophy, which claims that the state cannot bear the whole misery of the people, and the collectivist philosophy which aims to put all the means of production at the service of the community. That was not easily accepted in the early years of the 20th century. However, it progressively established the pillars of the social Republic and it induced the gradual construction of the French social model during the 20th century (Chemin, 2018).

In 2018, the president of the French Republic, Emmanuel Macron, when he spoke of the struggle against poverty, mentioned the "destiny inequalities"; by mid-September 2018, the French government announced an action plan against poverty and a series of measures aimed at repairing these destiny inequalities. At that time, the people living under the threshold of poverty could receive an income of active solidarity (RSA, French acronym) of *ca*. €550.93 for a single person; this income replaced the minimum income of insertion (RMI, French acronym), created in 1988. Both kinds of income aimed at facilitating the return to employment, so as to find a solution to mass unemployment which has been prevailing since the 1980s. In addition, an amount of €819 was allocated to handicapped adults (AAH, French acronym), for a single person without any resources; an allocation of solidarity for old persons (ASPA, French acronym) also existed, the amount being €833.20 per month and for single persons. Over time, the French system of social assistance has become complex, and even so one-third of the potential beneficiaries of this aid did not request it. A study of the Directorate for Research, Studies, Evaluation and Statistics (DREES, French acronym), published in June 2018, indicated that the amount of social aid reached 32.1% of the French GDP in 2016, compared with 27.5% in the European Union (average). More than 80% of the funds allocated were devoted to health and pensions (Charrel, 2018).

The struggle against poverty and exclusion, alone, amounts to *ca*. 1.8% - 2.6% of the GDP, according to the publication by the DREES. This meant €40.5 billion to €57 billion per year. "When one realizes that *ca*. 10% of the French population receives these different kinds of aid, it is not really costly," stated Jean-Luc Oudin, a researcher at the University of Paris-I. It should be nevertheless explained that without these aids, the poverty rate in France will not be *ca*. 13.6% but 23.6%. Exclusion is a reality and it is fuelled by unemployment. According to the OECD, the poverty rate would be halved if in all families one out of the adults had a job. France might be tempted by the British system, which includes more people at work, even though they often have precarious jobs (Charrel, 2018).

Malnutrition, as part and result of poverty

Socio-economic precarity is the primary cause of malnutrition in France. The study titled *Les consommations alimentaires des bénéficiaires de l'aide alimentaire en 2011-2012 en France* (Food Consumption of People Receiving Food Assistance in 2011-2012 in France called ABENA (French acronym) and carried out by France Public Health and updated on 9 September 2019 (*Revue d'épidémiologie et de santé publique, no. 60*, supplement 2), highlighted that obesity had increased by 20% for women and by 50% for men, between 2004-2005 and 2011-2012, hiding many nutritional deficiencies. Food assistance did not decrease during that period and was delivered to 14% of monoparental families that lived only with €2.3 per day and per person (child or adult).

The second cause has to do with the ageing of the population. In 2060, more than 20 million people will be more than 60-years old, 12 million will be more than 75-years old and 11 million will be more than 80-years old (figures from the French National Institute for Statistics and Economic Studies – INSEE); of these people more than 50%

would suffer from malnutrition. A number of chronic pathologies are also associated with malnutrition, such as kidney or heart diseases. Finally, it was noted that the level of ohospitalized patients' satisfaction regarding the quality of food intake fell down from 65.6% in 2011 to less than 50% in 2017; old people are heavily affected because, after losing weight due to insufficient intake, there is almost no recovery (Guibert et al., 2012; Zazzo, 2018).

Poor children and their bleak future

In 2018, 19.1% of the French people under 18 were living under the threshold of poverty, according to Eurostat. This figure was higher than that ot 2007 (15.3%), before the economic crisis. Olivier Thevenon from the OECD stated that "poor children are mainly part of families affected by unemployment." The majority of these poor children live in monoparental families, or in families where one of the parents, or both, are unemployed. "For these households, the difficulties of life are piling up, such as the lack of a stable job, poor housing, difficult access to health care, malnutrition; and all these conditions hinder the likelihood to climb up the social ladder," explained Sonia Serra, national secretary of the *Secours Populaire* (People's Emergency Assistance) [Charrel, 2018].

Children living in a small and crowded living space have 1.4 more chance to fail at school. According to the OECD and enquiries of PISA (*Programme international pour le suivi des acquis des élèves*, Programme for International Student Assessment), there is in France a very strong correlation between social level and school performance: children from poor families run the risk to be under the average performance at school, three times more than other children. The end result is that children from higher social-class families (e.g. managers, researchers, professors, executives) are more often (at least twice) graduated from universities and other higher-education establishments than workers' children. The French school system does not allow children to escape social determinism: 20% of youth leave schools every year without any degree or professional skills. According to Agnès van Zanten, a sociologist at the French National Scientific Research Centre (CNRS, French acronym), the failures of orientation of pupils at secondary-school level result in the persistence of inequalities; the precarious households cannot find their way through the numerous available training opportunities. In other words, "an education system is efficient for the training of the elite, but it fails regarding the transmission of a common base of knowledge to all pupils," summarized Louis Maurin, director of the French Observatory of Inequalities (Charrel, 2018).

In 2017, the ministry of national education made the decision to halve the number of pupils attending the first year of primary school. This measure was considered a good one, but it was not sufficient: to tackle children's poverty at its roots, we need to act still earlier. According to the OECD data, only 31.3% of the lowest-income households had access to nursery schools or to assistance for the mothers having a job (compared with 74% of well-off households). This often meant that mothers had to leave their job in order to take care of their children. Therefore, the measure announced in the 2018 action plan against poverty and aiming to alleviate the tax burden of day nurseries

or young-child-care centres, attended by poor children, was also very appropriate. But the competent organizations and NGOs insisted on the need to combine actions targeting children with all the measures that can improve housing and employment of their parents (Charrel, 2018).

United Kingdom

Change in eating habits in times of recession

The United Kingdom is a prolific producer of television chefs – e.g. Hugh Fearnley-Whittingstall, Jamie Oliver, Gordon Ramsey – all of whom insist on fresh food ingredients and the virtue of cooking from scratch. It exports its cooking shows and its celebrity chefs around the world, even to France. But the reality of what goes on in British kitchens has often been rather far from the televised ideal, especially in times of recession. Before the economic crisis (2007-2008), the British diet seemed to be improving. Admittedly, people were buying fewer green vegetables, continuing a long-term trend driven by declining appetite for cabbage, cauliflower and Brussels sprouts. But they were more or less making up for that by eating more salad leaves and fruit. They were purchasing more healthy fish and less fat. The average Briton bought 170 g of fish per week in 2006 – the most since at least 1974. Sales of organic food were soaring (*The Economist*, 2012).

Then came the financial crisis, a commodity price surge and government belt-tightening. Retail food prices in the United Kingdom have increased by 25% since January 2008, considerably more than overall inflation. Among the poor, the proportion of household spending that is devoted to food has risen slightly since 2007, to 16%, reversing a long downward trend. The first thing to go was eating out, stated Giles Quick of Kantar (*The Economist*, 2012). Kantar is the world's leading evidence-based insights, marketing data and consulting company. The Kantar group is the data-management-and-analysis division of WPP that is a creative transformation company, with leading global networks across all communications, experience, commerce and technology disciplines. Tha Kantar group has a complete and rounded understanding of how people think, feel and act; globally and locally in over 100 markets (countries). By combining this deep expertise, data resources and benchmarks the group helps its clients to understand people and their purchasing behaviour. Since 2007, Kantar has decided to set up a chart of eco-responsible good practices (e.g. energy savings, waste treatment) in order to respond to its clients' environment consciousness. With 60 years of experience in 2019 and relying on a team of 3,600 experts across 100 countries, Kantar, directly or with its partners, helps its clients in such fields as communications, commerce, technology, public relations, branding and design, health and wellness. Kantar claims that they know more about how people live, feel, shop, vote, watch and post worldwide than any other consulting company.

The consumers were less worried about sustainability and the environment. The Soil Association reported that sales of organic products in Britain had slid by 21% since 2008. After that, consumers began to make more painful compromises. Fruit and vegetable sales have sharply declined, along with sales of the so-called "primary

proteins", that is slabs of meat and fish, which impose additional costs on consumers because they require other ingredients to make a meal. The United States have seen a similar, though less extreme, shift. These changes were most pronounced among the poorest one-fifth of the population. But they were by no means restricted to the poor (*The Economist*, 2012). Customers are visiting more often but buying less when they do. Sainsbury's, a big supermarket, found that the number of customer transaction per week in the middle of 2011 was almost 22 million – 1 million more than a year earlier, but the number of items sold to each customer fell. Impulse buying was down too. IGD, another market-research firm, found that the proportion of British people who usually decide what to buy before going shopping jumped from 47% to 67% between 2008 and 2011. This list-making tendency largely explained another, benign change: British people were throwing away less food. WRAP, which tracks rubbish, estimated that households disposed of 7.2 million tons of food waste in 2010 – down from 8.3 million tons in 2006-2007. People were throwing away less of everything, but food still accounted for more than half of the overall drop. Yet, there may be another reason British people were throwing less food away: they were doing less cooking (*The Economist*, 2012).

Many people spend more time watching people cook than doing it themselves. The average time taken to prepare the day's main meal is just 34 minutes, according to Kantar (see above for Kantar); it has fallen sharply over time. Prepared food, which is seen as cheap and cheering, was the great winner of the economic slump. Pizza and meat-based ready meals have fared especially well. "Five a day", the campaign to prod people to eat more fruit and vegetable, was failing. Andrew Lansley, the health secretary at that time, was trying to persuade the food industry to cut the number of calories in meals. This has worked for salt. But this effort may be trampled by consumers stampeding for cheap, easy nutrition. Like the fall of fruit and fish, the rise of ready meals was most pronounced among the poor, but everybody favoured them. Marks and Spencer, grocer to the upper and middle classes, has scored with its "Dine in for £10" deal, introduced in 2008. The firm opened 29 stores in 2011, 26 of them food shops. Grocers like M&S and Waitrose were capturing better-off families who were trading down from restaurants (*The Economist*, 2012).

Yet these dramatic changes in diet were not always evident in supermarkets. Morrisons, originally a northern English chain, touted precisely the sort of foods that people have stopped eating (fresh fish in particular). Yet it has fared well in the past few years. Extravagant displays of fresh produce are a useful signal to customers, stated G. Quick, because they suggest the shop is good at food. Fruit and vegetables in supermarkets are increasingly a sign of quality, rather than something you eat. As eating habits have changed, so has the definition of cooking. Paul Gardner, who owns a Budgens grocery store in Islington, said things like rhubarb and Brussels sprouts hardly sold those days. What flied off the shelves, he stated, were nicely packaged, fresh seeming sauces that could be added to fish and meat to make a quick meal (*The Economist*, 2012). Some of these changes in diet intake of British people have persisted after the economic crisis, and as usual poor people were more affected by these conditions than the upper and middle classes. And London is still renowned as a citywide culinary flowering (see p. 204).

An impossible reform of social aids

In 2010, the British government announced a wide-ranging reform of all social aids. Six of these were amalgamated into a "universal credit" with the main objective: anyone who is entitled to these aids should not lose money, when he finds a job. "Working should pay back," as often summarized at that time by Iain Duncan, the minister who was at the forefront of the reform. The latter started in 2013 and was supposed to be completed in October 2017, and *ca*. 7 million of British citizens were to benefit from it. Unfortunately, by the end of 2017, only 700,000 people received the "universal credit", i.e. 11% of the total. This catastrophic result also meant that the completion of the reform was postponed to 2023. The British administration has been confronted with the complexity of merging the various kinds of aid: the criteria for cashing each kind of aid were not the same, computer systems were also different, all these factors made the reform difficult to achieve. Even those who were receiving the "universal credit," cashed it six weeks after their request, while they were living in very difficult conditions (Albert, 2018).

Food banks belonging to the Trussell Trust, a British charitable organization, are overwhelmed with persons that are the victims of this reform: 38% of the people attending the banks to take their three-day food rations, did not yet receive their social allocations or had been informed of a change in these allocations. The region of Hartepool, in the northeast of England, was among the first regions to start delivering the "universal credit." This experience was fraught with serious difficulties, e.g. many of those who attended the city's food bank had no savings that would enable them to wait for their social allocations; they were often on the rim of the cliff to fall down. If only one single payment failed to be delivered, they might not be able to feed themselves, or to feed their children. Nevertheless, when the system of "universal credit" is well established, the situation sounds much better (Albert, 2018).

One of the reasons for the difficulties experienced when setting up the reform has been some confusion of objectives: the "universal credit" was mainly aimed to reduce poverty, but also to make savings in the overall government budget. The launching of the programme coincided with the austerity policy decided by the British government in 2010. During the negotiations carried out with the British Treasury, the latter considered the "universal credits" were not a good thing and these suffered from budget slashing by the state. The parliamentary opposition made it a key issue and this even more complicated the implementation of reform. The government was nevertheless revising its objectives: in June 2018, it was foreseen that the reform will result in bringing back to work *ca*. 200,000 people in 2023. This was a paltry estimate compared with the 32.4-million British working market; we were therefore very far from the initial commendable objectives. It was ironic that the "universal credits" – designed in the early 2000s – came too late in the United Kingdom, where unemployment was almost non-existent – about 4% – but where the salaries are low and the jobs are often precarious. According to the think-tank Resolution Foundation, the "universal credits" should be focused on helping the families (households) having a job so as to support their income (Albert, 2018).

Conclusions

Poverty is a sad reality in Europe, it affects several millions of people, and in some countries a significant percentage of the whole population. We are obviously far from the tragic situation of some sub-Saharan or East-Asian countries, where people die from starvation and undernourishment, particularly children, women and elders. They are more and more submitted to extreme weather events, such as recurrent droughts, floods, hurricanes and typhoons – increasingly associated with the warming of the planet and global change. We have seen in the preceding chapters that international food assistance can alleviate some suffering of those starving people, but also that a multipurpose action is necessary at the national level to target the eradication of extreme poverty and hunger – through the increased supply of food and also the bold measures aimed at changing agriculture management, improving social justice and governance.

In Europe, poverty is measured in terms of a minimum income per month per person (*ca*. €1,000 in the wealthier countries of Europe and much less in the others) and governments are striving to increase this amount money, while *at the same time* – and this is where the difficulties lie – they must decrease the unemployment rate, improve the housing conditions, combat malnutrition, ensure better access to the health-care system, and finally address the problems of the poor children. By doing so, they may help the youth to escape their poor conditions and, through education and training, climb up the social ladder. "We cannot continue to be poor because we were born poor." That is the main challenge for the European societies. It is also relevant in other nations who make strong endeavours to combat hunger, poverty and malnutrition, to care about their youth and promote them along the social ladder, and thus afford them a better life.

China's farming challenge

Farms in China are too small to generate large profits, about 1.6 acres in average, compared with 400 acres (1 acre ≈ 4,047 m^2 or 0.5 hectare) in the United States. Although farm output remains high, yet it is difficult to consolidate these farms into larger more efficient operations because Chinese farmers do not own their plots – they lease them from the government. Privatizing farmland would allow market forces to create larger farms. But that would be politically risky for the Chinese Communist Party. It might also exacerbate inequality, by concentrating land ownership in the hands of a few while leaving many rural families not to see their future in the countryside. It is true that rural living standards have stagnated compared with those in the cities, and recent figures showed a threefold gap between urban and rural incomes (Johnson, 2014).

Chinese leaders have declared that fixing the countryside is crucial to maintaining social stability. In 2013, they unveiled a new plan for economic reform with agricultural policy as a centrepiece. In late September 2014, President Xi Jinping endorsed an experiment in Yangling (within the province of Shaanxi, central China) and in other

parts of China – the measure is called *linzhuan* – which aims to stop privatization, but gives the farmers land-use rights they can transfer to others in exchange of a rental fee. The goal was to stimulate a private land market and allow family-run, labour-intensive farms to change hands and be amalgamated into large-scale industrialized businesses. President Xi Jinping presented the policy as critical to China's next phase of economic reform. But skeptics stated that the Chinese government remains unwilling to consider a measure that worked in many countries: giving farmers full ownership of their land. It should be recalled that the Communist Party came to power in 1949 in a peasant revolution, and immediately collectivized the farmland. State ownership of land is also a major source of government revenue. In areas near cities, local officials often rezone agricultural land and hand it over to developers at a huge premium, sometimes triggering violent protests by residents who are left out (Johnson, 2014).

In Yangling, a district of 155,000 people that has been a centre for agricultural science since the 1930s, a branch manager of Yangling Rural Commercial Bank, stated he had made *ca*. US$3 million in mortgage-style loans since the *linzhuan* experiment stated. But he explained they were not true mortgages since the banks cannot repossess land if the farmer defaults – the state owns the land, not the farmer. As a result, the branch manager said he minimized risk by lending only to a large-scale vegetable and fruit farmers. A grain farmer, he stated, would never get a loan. Another issue has been figuring out how to set the rental fees that rural families collect if they translate their land-use rights. Yangling set up a land bank that took over land-use rights in an area of 36 square miles, then set an annual rental fee of at least US$750 per acre of land. Farmers could therefore choose between giving up their land and collecting that rent, or leasing their land back from the state and continuing to farm. But the fees, for instance, have discouraged production of grain, which does not sell for enough of a margin over the cost of renting the land. Grain paid only *ca*. US$1,250 per acre, for an annual profit of *ca*. US$500 (Johnson, 2014).

Why rental prices were so high? In some parts of China, rents were even higher than in Yangling, topping US$1,200 per acre (or 0.5 ha). By contrast, the average acre of farmland in the United States rented for US$136 in 2013, according to the United States Department of Agriculture. Some experts speculated that the rental fees had been driven up by the same sort of move that made apartments as expensive in Chinese cities. Even in a remote area like Yangling, an apartment of 1,000 square feet (*ca*. 100 m^2) sold for *ca*. US$50,000 (Johnson, 2014). Government planners hope that more farmers will be moving to the cities so the countryside gradually depopulates and ever-larger-scale farming takes over. For farmers with a job already lined up in the city, this system is attractive. But for people still wanting to farm the land they have not made to say. That is probably a big challenge for China's agricultural future: the ownership of farmland and the future of peasants (Johnson, 2014). Although it is undeniable that China is withdrawing out of poverty hundreds of millions of people a year – many of them being poor farmers – agriculture which was a driving force of the post-Mao-economic boom in the 1980s, is nowadays facing a critical economic challenge: that of farmland ownership.

Rice in Asia and governmental pricing policies

Asia consumes 90% of the world's rice. It is used to make flour, noodles (*ramen*) and puddings. Both babies and the elderly survive on rice gruel. Steaming rice porridge is eaten for breakfast by all social categories of people. Alcohol is made from rice – be it *sake* in Japan or rice whiskey in Thailand. But rice is not just a main foodstuff. It has religious and cultural (use) across Asia: it appears on Buddhist altars and in offerings to deceased ancestors; farmers pray to gods who have an influence on the forthcoming harvests and they thank them afterward. In many Asian languages or idioms the verb "to eat" literally means "to eat rice". Every Asian country believes its own rice is superior: Thais love the fragrance of the local jasmine rice; Indians praise the fluffiness of *basmati*; Japanese rave about the delicate texture of *koshi-hikari* from Niigata prefecture. It is very difficult for a country to culturally depend or rely on foreign rice (*The Economist*, 2015b).

The early adoption of higher-yielding rice varieties during the Green Revolution in the 1960s and 1970s briefly helped Indonesia and the Philippines to achieve self-sufficiency in rice in the 1980s, but for most of the past century they have been importers. The rice-exporting countries on the mainland have a big competitive advantage, because of large river deltas, which offer the best environment to grow rice and handy means to transport it. Peninsular, island and archipelagic countries such as Indonesia, Malaysia and the Philippines lack vast areas of flat, swampy land. Their farmers produce more rice per hectare, but possess a far smaller area under cultivation. Many governments look back with fear to the rice-price spike of 2007-2008, seeing it as a reason to build up domestic production so that they are not dependent on the vagaries of the international market. In fact, the rice market is fairly stable: production has largely matched or exceeded population-growth rates in Asia. And global rice prices are no more volatile than those of the other two global staples, wheat and maize, of which the prices also rose steeply in 2007-2008 (*The Economist*, 2015b).

But wheat prices rose because of weather-induced shortages and maize prices jumped because of increased demand of ethanol production (at least during certain periods and also in the United States mainly). Rice prices shot up because governments panicked. India restricted exports, which made the international prices soaring. The Philippines, which had low government rice-stocks but ample private stocks and was expecting a record harvest, bought massive quantities of Vietnamese rice at above-market prices. That had an effect on the spike of rice price in Vietnam. Thailand was creating a rice-exporting cartel, inspired by the OPEC (Organization of Oil-Exporting Countries), with Vietnam, Cambodia and Myanmar (Burma). Elsewhere, smaller exporters cut exports while importers and farmers hoarded rice. Prices did not start falling until the second half of 2008, when Vietnam, Japan and Thailand all stated that they would boost exports, and oil and shipping costs started declining (*The Economist*, 2015b).

But governments continue to intervene across the market. They offer trade restrictions, price support and hefty subsidies on power, fertilizer and water, mainly to keep domestic prices stable, provide supplies in times of crisis and protect domestic farmers. This approach has worked in a sense: across Asia, domestic rice prices are relatively stable.

But the countries trying to reduce imports tend to have higher prices than exporting countries. Japan, for instance, maintains its network of heavily subsidized small rice farms; the average age of its rice farmers is *ca*. 70. Japan imports rice and taxes it heavily: tariffs on milled rice were to remain at 778%, even after it eventually joined a trans-Pacific free-trade agreement under which Japan agreed to lower tariffs on other agricultural imports (*The Economist*, 2015b).

In the case of Indonesia where nearly 16% of the country's 250 million people survive on US$1.90 a day or less, as do more than 6% of Cambodia's 15 million people, by mid-2010s, rice is the staple crop that provides more than half the daily kilocalories of the poor. Like many Asian countries, Indonesia wants to be self-sufficient in rice. But as well as trying to help farmers become competitive through investments in agriculture and infrastructure, its government, like others in the region, manipulates the rice market through subsidies, tariffs and other support mechanisms for domestic producers. Indonesia's government, like that of the Philippines, determines the volume of rice imports. The quota varies from year to year, depending on how good the local harvest is expected to be. Both countries also set a floor price for consumers. Vietnam, a leading exporter, uses quotas to restrict the amount of rice leaving the country, and thus stabilizes domestic prices (*The Economist*, 2015b).

Furthermore, governments not only dictate the volume of trade, they also buy rice directly. For instance, for more than a decade, China's government has been buying rice from local farmers at above-market rates to maintain its stockpile. The Indian government also guarantees farmers a price in theory, but many do not receive it. The National Food Security Act, passed in 2013, is supposed to ensure that the poor can buy rice from the government at below-market rates from a network of *ca*. 60,000 fair-price shops. This is considered an inefficient system, which provides many opportunities for corruption. By some estimates, more than half the grain is withdrawn from the distribution network; and also tons of rice intended for the poor remain in bad storage conditions in government stockpiles (*The Economist*, 2015b).

Indonesia also maintains a similar rice-distribution programme, spending around US$1.7 billion each year to distribute subsidized rice to *ca*. 16 million families. This scheme has been suspected by allegations of corruption. In 2015, an OECD (Organization for Economic Cooperation and Development) study found that as a result of Indonesia's various policy interventions rice cost *ca*. 60% more than on the world market. In 2012, Thailand set up a plan to buy rice from farmers at above-market prices, hoard it to drive up global prices (at that time Thailand was the world's biggest exporter) and then sell it when prices rise. That design failed when growing Indian rice exports picked up, and it ended up costing the Thai government *ca*. US$16 billion, leaving a stockpile of 13 million tons and, as a result, the prime minister was impeached (*The Economist*, 2015b).

Rice farming in Asia is certainly playing an important role in providing sufficient volumes of this vital staple food. Steady improvements in agronomic practices, infrastructure and transport development, efficient storage facilities all tend to reach self-sufficiency in rice, and to provide enough rice to the poor and undernourished people. However,

it seems that governments should pay more attention to their economic policies regarding rice local prices. In particular, higher prices (above the world's levels) lower purchasing power and increase poverty in rice-importing countries. Studies in Bangladesh and Indonesia have found that higher rice prices are associated with higher rates of malnutrition (*The Economist*, 2015b).

Ethiopia's agricultural revolution and struggle against hunger

The following example shows how an African country – the second largest of the continent – Ethiopia, once hit by biblical of famines, has tried to transform its agriculture to meet its food needs, and even to become an exporter of profitable foodstuffs. Some speak of an "agro-revolution" in this still a poor country, but may be an example for many African nations. One of the many Ethiopians behind this transformation is Eleni Gabre-Madhin, who was entrusted by the former prime minister of Ethiopia, Meles Zenawi (who passed away in 2012) to design the agricultural strategy of the country. This was in 2003 when Ethiopia was going through a food crisis, after a lecture by a World Bank's economist who explained the benefits of creating a stock of exchange of commodities aimed at providing a stable income to the farmers. In 2005, Eleni Gabre-Madhin resettled in Ethiopia for the International Food Policy Research Institute (IFPRI, Washington, D.C.) with a view to improving agricultural policies and markets (Wuilbercq, 2018).

In 2008 was created the Ethiopia Commodity Exchange (ECX) – a stock exchange where basic commodities such as maize, sesame and coffee were commercialized. Eleni Gabre-Madhin was born in 1964 in Addis-Ababa, but as a girl spent little time in her country; she used to travel with her father – a high civil servant at the United Nations – and visited Rwanda, Togo, Malawi, Kenya and the United States. She studied agro-economy at Cornell University, Ithaca, New York State, and also at the University of Michigan. After having worked as an expert of agricultural-product markets at the United Nations Conference for Trade and Development (UNCTAD) in Geneva, she went back to Stanford University, California, to do her Ph.D. During her studies, she realized that the small farmers and producers were forced to sell their production at a low price in order to avoid stockpiling it; as a consequence they earned one-third of the selling price. This was a clear signal for her approach to bringing a fair solution to the issue: there was a need to regulate the market prices and to progressively integrate the middle-men (intermediaries) with the formal economy, so as to reduce the price volatility and to improve the farmers' productivity (these represented *ca*. 80% of almost 100 million inhabitants of Ethiopia). In other words, there was a need for a body where sellers and buyers could exchange their goods (Wuilbercq, 2018).

With the approval of the prime minister (at that time Meles Zenawi), a consortium of five funding institutions – including the World Bank and the United Nations Development Programme, UNDP – trusted Eleni Gabre-Madhin and supported a stock exchange for agricultural products with a total funding of €16.6 billion. The Ethiopian government made the decision to prohibit the exchange of some agri-products outside the Ethiopian Commodity Exchange (ECX). The result was outstanding: after three years of functioning, the ECX had a turnover of US$1.2 billion (€1 billion) a year, thus making

the ECX to become autonomous thanks to the participation of millions of farmers and to the commissions cashed after each transaction (Wuilbercq, 2018).

Elini Gabre-Madhin wanted to "replicate" the Ethiopian experience in Ghana, Tanzania and Cameroon, through her company, Eleni LLC, which is a private-public partnership. But she had to acknowledge the fact that the private sector in these African countries was more active than in Ethiopia, and consequently it was not that easy to replicate the model. Her projects were therefore far from being operational. The success of the Ethiopian case ("unique, fast and decisive") was largely due, according to her, to the kind of authoritarian regime who made agriculture among the top development priorities and the driving force behind the high economic growth rate of the country (8.3% in 2017, according to the World Bank). However, the Ethiopian economist, after having benefited from the system, stated that this kind of development induced solely by the state could not last for ever. There are too many constraints and bureaucratic hurdles that should be eliminated. To escape this kind of situation, she faced another new challenge: to create a startup incubator called Blue Moon (Wuilbercq, 2018).

Eleni Gabre-Madhin had to leave the ECX which she led until 2012. She nevertheless continues to provide her advice and she recognizes that an alliance with other stock exchanges, as it is done elsewhere, would enable ECX to discover new approaches and even to reinvent itself. In Ethiopia, the ECX is also in charge of the storage of commodities, managed by a state-run company. "Such kind of role should not be fulfilled by a stock exchange." Nor by the state. But it seems that the new and present government of Ethiopia is making some welcomed change in governance, while keeping the top priority for agriculture. Chinese assistance in terms of infrastructure (roads, trains, dams) will also be very helpful, if managed properly (Wuilbercq, 2018).

Eleni Gabre-Madhin has built up an undeniable credibility thanks to her experience and her strength at the field level. Despite the critical comments by some of her former employees, she won the reward of becoming one of the 125 most influential women in the world, in the 2013 ranking established by the United States magazine *Newsweek*. She has made tireless efforts to improve the life of Ethiopians and, as commented by Zemedeneh Negatu, chairman of the capital-investment fund Fairfax Africa, based in Washington D.C., "the fact that her startup incubator was focused on the agricultural sector should be considered as a major advantage, because Ethiopia's economic growth was largely dependent on agriculture." Eleni Gabre-Madhin indeed had claimed that "agriculture was the new frontier, and that was even the case in the Silicon Valley" (Wuilbercq, 2018).

Ethiopia is still a poor and developing country. As in many other African countries, it endures political crises due to rivalries between ethnic groups, which implies a governance based on a delicate balance between these groups. Despite these constraints and a development model imposed by the state during many years under the leadership of Meles Zenawi, the country has enjoyed high economic growth rates and great progress in its agricultural development and output. A world leading producer and exporter of sesame, Ethiopia can also add coffee, vegetables, fruits and flowers to its exports. Experts consider that, like in other East African countries,

such as Kenya, much progress is expected from the development and expansion of communication technologies (only a paltry 15% of the whole population is connected to the Internet, according to Internet World Stats); as well as from the elimination of bureaucratic regulations that hamper creativity and the development of startups. The name of Eleni Gabre-Madhin will certainly be reminded for her tireless efforts to promote the development of an innovative agricultural pattern, with the aim of feeding her fellow citizens and even becoming a commodity-export country.

Mauritius' agriculture: curbing dependence on sugar

In Mauritius, sugar cane has been a big part of the island's agriculture since the 17th century. Dutch colonizers started growing sugar cane for the production of *arrack*, a strong, clear, distilled liquor they had discovered in South-East Asia. Sugar contributed to the island's industry – first as raw material for distillers, then as a commodity shipped around the world. Even into the 1970s, sugar represented *ca*. 95% of Mauritian gross domestic product (GDP), and the sugar cane was grown on a third of the island's area. But the growing global competition, due to the rise of new sugar-cane important superpowers such as China, Pakistan and Brazil, and wanting preferred treatment from the European market, have taken their toll on sugar prices. Although still grown on *ca*. one-fourth of the island's agricultural area by mid-2010, sugar in 2015 represented only *ca*. 1% of the island's GDP (Schuetze, 2015).

When a case brought to the World Trade Organization (WTO) in 2004 first threatened the guaranteed price of Mauritian sugar on the European market, Medine – one of the largest commercial sugar plantations – which owns farmland covering 5% of the island's agricultural area, decided to revamp its business, establishing separate property and leisure clusters, and detailing a 25-year master plan. Although Medine's sugar and rum are still exported – the company is even actively reclaiming fallow land to expand its agricultural division – it now grows vegetables for local consumption, runs a resort village and attracts international tourists to its natural safari park. The Mauritius Sugar Syndicate, which represents local sugar growers and millers abroad, has invested in the production and marketing of so-called special sugars – various grain sizes of brown sugar, sometimes organically produced – that can be sold directly to consumers and command a premium price. The syndicate has been promoting thereafter Fairtrade sugar, of which it hoped to export 40,000 tons in 2016, a little less than 10% of all Mauritian sugar sold abroad. "The next phase is going to be all about sustainability," stated Devesh Dukhira, who ran the syndicate by the end of 2015 (Schuetze, 2015).

Commercial farms, but also smaller farmers, have been trying to curb dependence on sugar and to look for alternatives, such as higher-value crops that can be sold globally at premium prices. Nevertheless, "no one is talking about giving up sugar," stated Michael Teig Rountree, who was running Bel Air, a 390-hectare sugar farm that has been owned by his family since his ancestors emigrated from Ireland in the early 19th century. Having tried livestock feeds like alfalfa (lucerne), soybeans and corn, T. Rountree, whose farm lies on the lush southern side of the island, started growing a premium rice, destined for health-conscious and well-off consumers in Europe and the United States. While Mighty Rice, as it was called, was developed by cross-pollination

in Bangladesh, its black-and-white packaging exalts the volcanic soil and rainfed streams of Mauritius – thus marketing the benefits of the place it was grown as much as its food quality. This rice, which is grown on dry land and so can be easily integrated into traditional farms, yields between four and six tons per hectare at a fixed price to farmers of US$800 per ton, earning them as much as US$4,800 per hectare. Sugar, by contract, has an average yield of eight tons per hectare, with a price of US$360 a ton, in 2015, i.e. US$2,880 per hectare. The retail price for Mighty Rice is higher as well. On the shelves of the Californian supermarket chain Raley's, a 15-ounce bag sold for US$4.99, which was seven to eight times more than the price for the same quantity of white cane sugar in the same store (Schuetze, 2015).

Vita Rice, a Mauritian company that started growing Mighty Rice in 2009 on its own 400-hectare farm, was formerly the site of a state-owned sugar-cane farm. In 2015, the company harvested and commercialized Mighty Rice for the third year. The annual production was *ca*. 1,470 tons of rice and it was poised to sell some 40,000 15-ounce bags in the United States – so far its main export market. The rice carries a certification guaranteeing that it is not genetically modified and free of arsenic – a potential contaminant in other commercially available rice. While the rice was not yet certified as organic, Mauritian rice farmers are taking no chances, fertilizing their soils with molasses to avoid anything that could affect the product. Premium rice is just one of the products farmers across the world are using to replace commodity crops, stated Luis A. Ribera, a professor of the Department of Agriculture of Texas A&M University. For instance, the State of Tamaulipas in northern Mexico has all but abandoned dry hay, corn and other row crops for irrigated vegetables destined for supermarkets in the United States. In other cases, vegetables replacing row crops or sugar cane in Central and South America are grown organically and sold at a premium (Schuetze, 2015). At a small scale, obviously, curbing dependence on sugar cane and the sugar industry shows (in Mauritius) a transition towards an agriculture with high-end offerings commercially successful and also with a marked contribution to healthier foodstuffs.

Is agroecology part of the solution?

Representatives of more than 70 countries gathered in Rome by June 2018 to discuss the agroecological approach to creating a healthier and more sustainable food-production system. This approach that combines innovation and tradition places ecological science at the centre of agriculture. That is why it is called agroecology; it includes: the use of compost as fertilizer and also biological nitrogen fixation in the soil thanks to herbaceous or tree legumes; steps to attract pollinators, as well as predators that feed on agricultural pests; crop rotation; no-tillage agriculture (leaving the plant material of an earlier harvest to be degraded by soil microorganisms and microfauna, and planting seeds of the following crop on the soil humus); promoting all devices that prevents the wastage of water in irrigation (70% of the world's sweet-water is used in agriculture), such as well maintained and managed traditional irrigation systems, drip irrigation, computerized trickling irrigation schemes; reduction, to the outmost possible, of the emissions of greenhouse-effect gases (CO_2 and CH_4 in particular).

At the above-mentioned meeting, José Graziano da Silva, the director-general of the United Nations Food and Agriculture Organization (FAO), who was, before being elected director-general, a minister of the government of Brazil led by Ignácio Lula da Silva, in charge of the struggle against hunger (programme *Fome Zero* or Zero Hunger), called for "transformative change toward sustainable agriculture and food systems based on agroecology." This endorsement from the FAO's director-general was considered encouraging for all the farmers from both the developing and industrialized countries who strive to adopt agricultural practices that increasingly respect the environment and mitigate climate change, but at the same time try to reach higher crop yields.

In more than a US$5-trillion global food system dominated by ever-growing corporate giants, industrial or highly intensive agriculture (e.g. most of American agriculture, with its addiction to monocultures and chemicals) is being highly criticized, not only by ecologists and "green" movements, but also by agronomists. A new reckoning known as true cost accounting is putting dollar figures on industrial agriculture's contribution to soil erosion and fatigue (loss of fertility), climate change and public health (animal and human) [Moss and Bittman, 2018]. These criticisms are undoubtedly valid, but it should be recognized that intensive agriculture (including advanced agronomic research) largely contributed to feeding numerous populations, particularly in Europe, after the vast destruction caused by the Second World War. For instance, France could thus not only feed itself, but became an exporter of agricultural products (cereals). Not to mention the case of the United States which to a large extent led this agricultural revolution. The Green Revolution of the 1960s and 1970s also contributed in Asia and Latin America to increasing crop yields (maize, rice and to a lesser extent wheat), with the use of new crop varieties that needed irrigation and the addition of both fertilizers and pesticides. Intensive agriculture is certainly needed for food and feed production to enhance the production capacities of a number of countries, which have been left aside by this agricultural revolution (particularly in Africa); but this has to be done with a rational approach, i.e. obtaining higher crop yields, when starting from very low ones, along with good agricultural practices in terms of inputs, water consumption and CO_2 emissions (see Sasson, 2013).

At the same time, more and more countries – pushed by networks of small and medium-size farmers like La Via Campesina – are actively shifting to policies and investments that support agroecological food systems. For instance, in India the State of Andhra Pradesh, home to 50 million people, is investing US$200 million to convert its farmers to the agroecological practice known as zero budget natural farming, which uses from-the-farm nutrients to grow crops without using costly chemical fertilizers or pesticides, which sometimes can push farmers into debt. More than 200,000 farmers there are already using this method, and an estimated 500,000 farmers in 3,000 villages were to move to this method by the end of 2018, i.e. three years ahead of schedule, according to organizers. The government planned to invest US$2.3 billion to expand this kind of agriculture to six million farmers within five years (Moss and Bittman, 2018).

In Africa, the African Centre for Biodiversity, a research and advocacy organization, has urged the Tanzanian government to phase out subsidies for chemical fertilizers and speed a transition to agroecology through support to small farmers. In Ghana, the

Centre for Indigenous Knowledge and Organizational Development, a non-governmental organization (NGO), is working with local chiefs to promote sustainable forestry practices that restore soil moisture to slow the encroaching Sahel desert. Both organizations are part of the Alliance for Food Sovereignty in Africa, a network that pushes governments to pass laws that ensure food security by supporting farmers to breed and distribute climate-resilient seed varieties. In West Africa, France is planning to spend €8 million to foster agroecology. In the Americas, the Agroecology Collective in Ecuador is strengthening a network of municipal farmers' markets to achieve a national goal of food sovereignty that is enshrined in the country's constitution. The president of Mexico, Andrés Manuel López Obrador (AMLO), has endorsed a plan to make agroecological principles the driving force behind Mexican agriculture (Moss and Bittman, 2018).

Industrialized countries with intensive agriculture are also devoting more attention to agroecological agriculture. France, for instance, has committed €1 billion to help a majority of its farmers adopt agroecological practices by 2025, through training, support and research and development. And in the United States, the Good Food Purchasing Program has developed a system that helps cities and large institutions direct their buying power to locally and sustainably grown food. By mid-2018, it has already been adopted by the cities of Los Angeles, San Francisco and Chicago. New York City will probably be next as well as several other cities. Intensive-agriculture supporters, however, react to agroecology as something not being able to feed the world. Of course, they recognize agroecology's power, as seen by its increasingly greenwashed marketing. But agroecology is based on science and on-the-farm experimentation, with its roots in the practices of farmers who know their land and crops, and the scientists who work with them to improve their sustainable agricultural practices. A 30-year-long comparison by the Rodale Institute of organic and chemical agriculture in the production of maize and soybeans found that, after an initial decline in the first few years of transition from fertilizers and pesticides, the organic method "rebounded to match or surpass the conventional system." These practices regenerate soil fertility and biodiversity (Moss and Bittman, 2018).

Agroecology measures its success by a yardstick that includes not only tons and kilocalories but how well food nourishes people while regenerating soil and water and helping more farmers to improve their living. Agroecological techniques also contribute to sequestering carbon, encourage multicropping, preserve local seed varieties instead of replacing them with patent-protected and unaffordable varieties, support local businesses operating close to farms (reducing the circuit between producers and consumers), and often creating jobs. "Bringing farming back to nature," as stated by Moss and Bittman (2018), is certainly a sensible approach that includes securing land tenure for farmers and indigenous people, making local markets work for small- and medium-scale farmers, and fostering public policies that combine environment-friendly farming and the production of healthier food. But it seems unreasonable to completely exclude intensive agriculture for the time being, but agroecology offers a reasonable gradual transition from a food system to another one, with the support of good agronomic and environmental sciences (Sasson, 2013).

Possible contribution of precision agriculture

In addition to agroecology, precision agriculture can bring some assistance to solving problems associated with insufficient agricultural production, not only presently but increasingly in the medium and long term, and in both developed and developing countries. There are, for instance, many startups in the Silicon Valley, California, who are working in the agricultural sector. They do believe that agriculture is going through a revolution: after mechanization of agriculture that occurred in the 1920s, advances in the genetic selection of crops in the 1960s-1970s, and the development of pesticides, we are entering the era of precision agriculture, ag-tech, that uses robots and artificial intelligence (big data processing). The innovations derived from the ag-tech are expected to increase crop yields, to shorten the distance between producers and consumers and to mitigate the impact of agriculture on the environment. According to Sarah Williams, in charge of Food System 6, a non-profit incubator of startups, "the sector is ready for a 'disruption' and it is the consumer who drives the change." The consumer used to give priority to "the price, the taste and the practical aspects of food," but now he is concerned about "well-being, safety, social impact and transparency," stated Rick Nanda, an analyst who worked at Deloitte (Lesnes, 2017).

In the case of California, its agriculture – the first producer of fruit and vegetables in the United States – had to adopt this ag-tech, because there has been since the 2008 economic crisis a chronic lack of humanpower, due to the return of many migrants to their countries of origin. In addition, the cost of this humanpower has become higher. In 2014, the average minimum salary has been raised to US$8-9 (or €7 to €7.90), and it was expected to reach US$15 in 2022. Working hours beyond the regular ones should be remunerated 8 hours per day (compared with 10 hours in 2017). The cost of humanpower is more than half the cost of production of fruit and vegetables (between 50% for berries to 70% for asparagus). In addition, at the beginning of 2017, the threat of the United States' administration to expel the people without official registration documents worsened the situation, because 70% of agricultural workers in California lack these documents. Consequently, confronted with the lack of humanpower and the stagnation of agricultural output, farmers are willing to accelerate the robotization of some of their practices (Lesnes, 2017).

However, there is not yet a definitive step in that direction. Because robots cannot yet pick up strawberries or cherries hidden among the leaves of the tree, with the same skills as agricultural workers. But the relevant startups are increasing their creativity, taking advantage of the progress made in computer vision and in the recognition of images. For instance, Abundant Robotics, ubicated in Hayward, in San Francisco Bay, has developed a prototype that selects ripe apples, through analyzing their sugar content, their colour and the way they reflect light, and thereafter picks them up thanks to his arm equipped with an aspirator. This robot is tried in Washington State on espalier trees. The startups have been able to receive US$10 million on 4 May 2017 from Google Ventures, after an initial funding from Yamaha Motor Company and Comet Labs (Lesnes, 2017).

Founded in 2016, AgriData has developed a robot that can evaluate the production in orchards, with a view to enabling the farmer to optimize his costs. Four cameras and a case are installed on a tractor that is driven through the vineyards and records 20 images per second on both sides. These images are analyzed and transformed into maps where can be seen the number of grapes per bunch and their size. According to the chief executive officer (CEO) of AgriData, Cyrille Habis, who has a degree in computer vision from Stanford University, "more than 90% of the fruits are recorded, whereas the human vision cannot reach more than 60% of them" (Lesnes, 2017).

Besides robotics, investors are also interested in the utilization of satellites and captors in order to monitor almost each plant, in "vertical" agriculture (hydroponic agriculture), in genome editing and traceability of foodstuffs. "Investments in ag-tech started after the purchase in 2013 of a startup, The Climate Corporation, that can predict crop yields, by Monsanto for US$930 million," stated Georges Nahon; one year later, the funds invested in this startup rose up to US$4.6 billion, and thereafter fall down to US$3.2 billion in 2016. "The next green revolution is the data," explained Micki Seibel who created in 2016 the sustainable food programme at Orange, Silicon Valley. At the end of March 2017, during the World Agri-Tech Conference, the startup Blue River Technology, Mountain View, Silicon Valley, has been awarded the innovation prize for its technology called "see and spray". The machine can "see" weeds and spray herbicides just on them. The technology has been tested on *Amaranthus* weeds that proliferate in the south of the United States and have become resistant to glyphosate – the bioactive component of Monsanto's herbicide Roundup. "Every weed counts" is the slogan of the startup that has been funded by Monsanto (Lesnes, 2017).

Precision tools are also used in livestock husbandry. Ubicated in Pescadero, 70 km south of San Francisco, the TomKat ranch is an experimental farm, funded by Tom Steyer, the former Wall-Street golden boy who became a devotee to environmental protection. The activity monitors, generally utilized by sports-men and women, are being applied to cows. They are placed in the animal's ear and they can monitor the number of walking steps, temperature and heart beat. The purpose of this kind of device is to detect diseases before they spread and to isolate the diseased animal as well as those which are close to it on the same grazing land. The statistical data collected also can help identify which bull or heifer is growing fast and puts weight on, while monitoring its walking distance and its intestinal microbiome. "Farmers are nevertheless careful in using these techniques," stated Micki Seibel. "They do not live at the same speed as in the Silicon Valley," added George Kellerman of Yamaha Motor Ventures. During the World Agri-Tech Conference held in San Francisco in March 2017, the CEO of Tom Farms, Kip Tom, recalled in this respect that in the United States the tractor was introduced into farms during the 1920s, but it was only in 1955 that it completely replaced horses and mules (Lesnes, 2017). However, there is no doubt that precision agriculture in the broad sense will contribute to increasing crop yields, while being at the same time environment-friendly. Some developing countries such as Brazil, Chile and others in Asia are using it and will increasingly rely on it, due to the fast growth of artificial-intelligence applications in all human activities.

Towards a distinct "planetary diet and lifestyle"

Yes, we shall be able to feed 10 billion people in 2050, while at the same time improving human health and protecting the planet. This is the optimistic conclusion of a large-scale study, carried out by a team of 37 experts from 16 countries during three years. These experts have worked together within the framework of a commission set up by the British medical review *The Lancet* and the foundation EAT, with funding from the British Wellcome Trust. These scientists specialized in pubic health, nutrition, agriculture, political sciences, environment, etc., have published their results in a voluminous publication dated 16 January 2019; and they gave the recipe of a "planetary diet and lifestyle," which meant a drastic change in our production and consumption habits (Willett et al., 2019).

While 1.6 billion people throughout the world suffer from starvation and undernutrition, and 2.4 billion people are obese, overweight and suffer from chronic diseases as type 2 diabetes, hypertension and cardiovascular diseases, and several hundred million people suffer from some kind of micro-nutrient deficiency, agrifood production remains our main means of feeding ourselves. However, the current agrifood production system produces almost 30% of the global carbon dioxide (CO_2) and greenhouse-effect gases; it occupies *ca*. 40% of the land and consumes 70% of available sweet water. Moreover, *ca*. 30% of fish stocks are overexploited. However, despite population growth, the scientists that signed the above-mentioned study stated that it is possible to have a sufficient, healthy and sustainable diet (Willett et al., 2019).

They have proposed that the daily calorie input should be 2,500 kcal per person, compared with the average 3,700 kcal per person in the wealthy countries and 2,200 kcal per person per day in the poor countries. The input proposed is considered sufficient for the maintenance of the human body. The scientists did not intend to impose only one type of diet; in the middle of the present century, there will certainly be meat eaters as well as vegetarian or vegan consumers. Nevertheless, on the basis of public – health criteria, the scientists have recommended a menu where vegetables and fruits play a major role: their daily consumption should be *ca*. 500 g per day. In addition, non-transformed cereals should bring one-third of the calorie intake, dairy products, a few spoons of seed oil, preferably non-saturated, and very little sugar should complete the diet. With respect to proteins, their contribution should be, to a large proportion, from plant origin (125 g per day); the recommended daily intake of red meat is 14 g only – or one steak or hamburger per week – while that of poultry and fish is approximately twice that amount. In other words, a healthy diet, according to the scientists and experts, would mean "to double the consumption of fruit, vegetables, nuts, and legumes, and to reduce by more than 50% the consumption of red meat and sugars. To sum up, the menu suggested by the scientists would be composed as follows (the total calorie intake being 2,500 kcal per day):

- non-transformed cereals (rice, wheat, maize, etc.) 232 g
- starchy plants (potato, cassava, etc.) 50 g
- legumes 300 g
- fruit 200 g
- dairy products 250 g
- proteins [125 g from plant origin: legumes (75 g), nuts (50 g); and 84 from animal origin (beef or lamb, 7 g; pork, 7 g; poultry, 29 g; eggs, 13 g; fish, 28 g)
- fats (40 g of non-saturated oils) 52 g
- sugar (added) 31 g

These figures are averages (e.g. in the case of red meat, the intake may vary from 0 g to 28 g, which gives some flexibility to the menu (Willett et al., 2019).

This standard menu (or "planetary diet") is flexible enough to take account of the diversity or range of "agricultural systems, cultural traditions and individual preferences," but also of the wide differences in lifestyle and diet between the wealthy and poor countries, as well as of the uneven access to food resources. Thus a North-American adult should divide by six his present daily intake of red meat, while an inhabitant of South-East Asia should double that intake. The scientists and experts of the study have calculated that through the adoption of their suggestions, 10.8 to 11.6 million deaths per year could be averted across the world; and this would reduce by 20% adult mortality (Willett et al., 2019; Le Hir, 2019).

There will also be a benefit for our planet. Such a diet would be compatible with a food production that would not imply an overexploitation of the ecosystems. The emissions of greenhouse-effect gases, particularly those of methane and nitrous oxide, would remain at the present level, while the area of farming land across the world (13 million km^2) and the uptake of surface and groundwater (2,500 billion m^3) should not change significantly. In 2050, population growth will mean an additional one-third of the present population to reach a total of 10 billion; such a growth demands a decrease, of the same size, in each inhabitant's impact on the planet's natural resources. The present inputs of nitrogen and phosphate fertilizers, which pollute aquatic environments, should be drastically decreased. Also, the extinction of many animal and plant species would have to stop and some improvement in biodiversity may occur (Le Hir, 2019).

Now, it remains to convince peoples, governments and the agrifood industry to be involved in a change that the researchers have qualified as a "new global agricultural revolution." To that end, these researchers have suggested five "strategies", that should be implemented only at global scale: an international commitment towards adopting a healthy diet; new agricultural priorities meaning the production of higher quality products; an intensification of food production, but that should follow a sustainable model; a strong and coordinated governance of the lands and oceans; and finally halving (at least) the losses and wastages of foodstuffs (*ca*. 30% of the present

production). Fabrice DeClerck, research director of the EAT foundation and one of the co-authors of the above-mentioned publication, stated: "We need to start having a common objective. The "planetary diet and lifestyle" that we suggest would be the equivalent, in the food area, of the objective of less than 2°C for global warming that the States set up as a goal in the area of climate change." And the researchers added that such proposal is "within our reach" (Le Hir, 2019).

In many experts' circles, there is a profound feeling that the agrifood industry must drastically change its production processes in order to market higher-quality products. In an interview with a former French agrifood industrialist, Christophe Brusset (who authored a book published in October 2018 and titled *Et maintenant, on mange quoi?* And Now, What Do We Eat? Paris, Flammarion ed.), the journalist Solène Lhénoret reported a number of his statements in the 18 January 2019 issue of the daily newspaper *Le Monde*. "The quality of foodstuffs, he said, has worsened, the industry being driven by the harsh competition over the food prices. Lower-quality products are being used and they are made acceptable to the consumers thanks to many food additives, such as pigments, taste enhancers (e.g. glutamate), water introduced into ham to make it heavier, emulsifiers, soybean proteins in order to lock in water;" in his view, "the big food-industry companies manufacture unhealthy products and they hide it." Marketing is another issue: the labels put on the food packages are useless or meaningless, and they sometimes contradict legally approved labels such as "on the farm product". Christophe Brusset told the story of French honey, one-third of it being imported from China at a cheap price, but of very poor quality; this situation was concealed, he said, and the consumer was deceived, despite the regulations set up in 2015 by the French authorities and in 2017 by the European parliament (Lhénoret, 2019a).

The European Food Safety Authority (EFSA) has been often criticized, especially by several non-governmental organizations (NGOs), because of its biased recommendations. The NGO Corporate Europe Observatory mentioned, for instance, that almost half of the experts hired by the EFSA would still receive fees or salaries from the agrifood industry. This kind of lobbying and other ways of influencing the decisions made about food regulations must not prevail anymore. Furthermore, there should be a fair price paid to the farmers or producers, and also a reasonable cost of foodstuffs for the consumer; and not too often granting a lion's share of the profit to the large distributors of foodstuffs. Regarding the information provided to the consumers, it should be simple and nevertheless based on scientific evidence. For instance, the Nutri-Score labelling (see p. 79) proposed in 2018 in France consists of aggregating all the nutrition factors into a code of three colours: green, orange and red. These summarize the nutritional qualities of the foodstuff. In addition, through the scanning of the label sticked on a foodstuff with a smartphone, one could have more details on the foodstuff composition and even obtain healthier alternatives. To sum up, the consumer is strongly advised to avoid the purchase of ultra-processed foodstuffs containing a long list of ingredients. By contrast, common sense should induce the consumer to buy organic rather than industrially processed products. He/she should trust official labels which indicate the quality and provenance of the foodstuffs. And why not, as much as possible, do some cooking, and thus avoid salt, sugar and choose the appropriate ingredients (Lhénoret, 2019a).

THE SO-CALLED JUNK FOOD: ITS DIRE NUTRITIONAL IMPLICATIONS AND THE BIG COMMERCIAL INTERESTS BEHIND IT

Ferocious battle over taxing sugar-sweetened beverages

Colombia

In this country, the organization called *Educar Consumidores* (Educate Consumers) is the most visible proponent of a 20% tax on sugary drinks that was heading for a vote in November 2017 in Colombia's congress. The group raised money, rallied allies and produced a provocative television advertisement that warned consumers how sugar-laden beverages can lead to obesity and diet-related illnesses like diabetes. The backlash was fierce: a Colombian government agency, responding to a complaint by the nation's top soda company that called the advertisement misleading, ordered it off the air. The agency even went further, prohibiting the NGO from publicly discussing the health risks of sugar, under penalty of a US$250,000 fine. Such an event showed how the battle over taxing sugar-sweetened beverages is becoming one of the world's most ferocious-policy fights – a clash of science, politics and commercial interests in many countries and cities (Jacobs and Richtel, 2017a).

In the United States, the soda industry has spent at least US$107 million at the State and local levels since 2009 (and up to the end of 2017) to beat back soda taxes and beverage warning labels. The experience in Colombia may be the most extreme, but industry opposition has killed or stalled soda-tax proposals across the world, including in Russia, Germany, Israel and New Zealand. Nevertheless, the idea is gaining momentum, because such levies have been enacted in 30 countries by early 2018, including India, Saudi Arabia, South Africa, Thailand, Brunei and the United Kingdom. More than a billion people live in places where such taxes have driven up the price of sugar-sweetened beverages. The battles have been particularly intense in emerging markets as the industry seeks to make up for falling soda consumption in wealthier nations. Latin America has surpassed the United States as the world's biggest soft-drink market, according to the World Health Organization (WHO) with sales of carbonated soft drinks doubling there since 2000 while they declined in the United States. Studies of soda taxes have shown they lead to a drop in sales of sugar-sweetened beverages – a 10% sales decline, for instance, over the first two years of Mexico's tax; however, such measures are so new that there is not yet evidence of their impact on health (Jacobs and Richtel, 2017a).

But public health organizations, including the WHO, claim that soda taxes are one of the most effective policy tools for cutting consumption of what nutritionists call a "liquid candy" that has contributed to an epidemic of obesity and related illnesses across the world. Kathryn Backholer, an expert on the issue at Deakin University in Australia, and other specialists stated that the turning point for soda-tax proponents came in 2014, when Mexico – Coca-Cola's biggest consumer market, per capita consumption – approved a 10% tax (Jacobs and Richtel, 2017a).

In Colombia where soft drink is often cheaper than bottled water, the soda-tax fight took place in a key market for beverage makers. Sales volume of carbonated drinks here climbed more than 25% over the past 15 years (since 2002); during that same period in the United States, it fell 12%, according to Euromonitor International, a market research organization. The big national beverage company, Postobón, a distributor of Pepsi-Cola, is part of a huge conglomerate that includes sugar-cane growers, sugar mills and the country's biggest media company, RCN Television, which helped disseminate the antitax message. In early 2016, Colombia, a nation of 49 million people, was facing the prospect of peace and stability, after decades of civil war and narco-terrorism. In March 2016, the country's health minister, Alejandro Gaviria Uribe, proposed a 20% tax on soda and sugar-sweetened beverages – the equivalent of *ca*. US$10 cents on a litre bottle. This measure was designed to inject US$ 340 million a year into Colombia's chronically underfunded national health-care system. But A. Gaviria had a more ambitious goal: to dampen soda consumption in a country with an obesity rate that had tripled since 1980 to almost 20% of adults. Each year, 4,000 people aged between 30 to 70 years die from obesity-related illnesses like heart disease and diabetes, according to the health ministry (Jacobs and Richtel, 2017a).

Encouraged by the health ministry's soda-tax announcement, a coalition of three dozen civic organizations, called the Alliance for Food Health, was formed. They received crucial support from Bloomberg Philanthropies, a foundation created by the former New York mayor Michael Bloomberg, which dispatched experts from the United States, and also provided pivotal funding, including US$260,000 for the public service advertisement. Opinion polls showed that 70% of the public embraced the tax, while only 42 legislators in the 268-seat congress stated they supported the measure. The debate escalated in August 2017 when television stations across the country began airing a public service announcement in support of the tax. Postobón, the soft-drink company, promptly filed a complaint with the government's consumer protection agency, the Superintendent of Industry and Commerce, claiming that the announcement (TV) unfairly suggested that all sweetened drinks were unhealthy. Nutrition experts responded that the announcement was wholly consistent with established science showing the impact of *excess sugar consumption* on weight and metabolic diseases like diabetes, gout and heart disease. The Harvard School of Public Health backed this assertion, including a point nutritionists make repeatedly: that sugary beverages lack nutritional value and add kilocalories without leaving consumers feeling full. But the head of the Colombian consumer protection agency, a presidential appointee, took the side of the industry petitioners, and a short time later, the agency ordered the commercial announcement withdrawal (Jacobs and Richtel, 2017a). The fight continued with a lot of intimidation and intense lobbying from the industry, and

despite the perseverance of the tax proponents, the industry won a victory on the last day of 2016: using a complex procedural maneuver, congressional leaders killed the soda tax, dropping it from the larger tax overhaul package (Jacobs and Richtel, 2017a).

By early November 2017, the country's constitutional court overturned the consumer agency's decision to silence *Educar Consumidores* and ordered the agency "to abstain from censoring any other announcement related to public health in the future," according to the ruling. "It was a great victory for free speech in Colombia," the representative of the NGO said. On the other hand, Postobón started what is called "a new social strategy focused on nutrition." The campaign revolved around *kufu*, a new mango-flavoured beverage formulated for children. It is part of the industry's goal of tackling public health through voluntary efforts. Postobón praised the drink's added vitamins and minerals, claiming they would "promote cognitive development, strengthen immunity and promote health bones," according to an account of the event published by the newspaper *La Republica*, acquired in 2016 by Postobón parent company, Organización Ardila Lülle. This was founded in the early 1950s by Carlos Ardila Lülle who owned many companies, such as an insurance company and several dealerships that sell Dodge, Jeep and Ford vehicles. Postobón stated it would spend US$120,000 to evaluate the initiative, which would provide free *kufu* each day to thousands of poor children in the Colombia's far north where the campaign took place. But according to the label on the drink, one juice box of it contains 13 g of sugar, more than half of the daily-recommended dose for children (Jacobs and Richtel, 2017a). The Colombian example shows how ferocious could be the battle over sugar-sweetened beverages, with the big commercial interests of the industry – with all its strong lobbying power and intimidation – confronting the public-health issues of a large part of the population which suffers from overconsumption of sugar. The soda-tax proposal still remains an effective way to decrease that overconsumption.

Mexico

The case of Mexico is even worse than that of Colombia. Too much sugar and too much fat in the diet have dire implications for the health of people, and particularly the poor. For instance, in San Cristóbal de las Casas, a mountain city in the southeastern State of Chiapas, potable water is increasingly scarce: some neighbourhoods have running water just a few times a week, and many households are forced to buy water from tanker trucks. So, many residents drink Coca-Cola, produced by a local bottling plant; it can be easier to find than bottled water and is almost as cheap. In Mexico that is among the world's top consumers of sugary drinks, Chiapas' residents drink on average more than 2 litres of soda a day. The effect on public health has been devastating: the mortality rate from diabetes in Chiapas increased 30% between 2013 and 2016, and this disease is now the second leading cause of death in the State after heart disease, claiming more than 3,000 lives every year. The diabetes epidemic and the chronic water shortage pushed the residents of San Cristóbal de las Casas to believe that the culprit of that situation was the Coca-Cola factory, on the edge of the city, that has permits to extract more than 300,000 gallons of water a day (1 gallon ≈ 4 litres). This was part of a decades-old deal with the federal government. Coca-Cola executives and some outside experts stated that the company had been unfairly vilified for the water shortages. They blamed rapid urbanization, poor planning and a lack of government investment in the city's infrastructure (López and Jacobs, 2018).

The Coca-Cola plant is owned by Femsa, a food and beverage giant that has the rights to bottle and sell Coca-Cola throughout Mexico and much of the rest of Latin America. A former chief executive of Coca-Cola in Mexico, Vicente Fox, was the country's president from 2000 to 2006. Femsa executives said the plant had little impact on the city's water supply, noting that its wells are far deeper than the surface springs that supply local residents. On the other hand, the company is an important economic force in San Cristóbal, employing *ca*. 400 people and contributing *ca*. US$200 million to the State's economy. In 2017, Femsa began talks with local residents to build a water-treatment plant (to treat raw sewage that otherwise flows into local waterways) which would provide clean drinking water to 500 families in the area. But rather than easing tensions, the plan led to more protests by locals and forced the company to halt construction of the facility (López and Jacobs, 2018).

Since bottles of Coca-Cola had arrived in Chiapas a half-century ago, the beverage has been deeply intertwined with the local culture. But now and for many in San Cristóbal, the ubiquity of cheap Coca-Cola – and the diabetes that hits nearly every household – simply compounds their anger towards the soft-drink company. Femsa keeps rejecting criticisms that the company's beverages have had a negative impact on public health. While scientific research does not suggest that Mexicans of indigenous ancestry have higher rates of diabetes, local advocates claim this puts even greater responsibility on multinational companies that sell products with a high content of sugar (López and Jacobs, 2018).

Transformation of Mexican diet

The case of San Cristóbal de las Casas in Chiapas illustrates what has been happening in Mexico for decades: the transformation of the diet towards cheap, high-calorie food (too much fat and sugar), bringing diet-related illnesses. This applies to a great extent to social categories with low income, living in poverty, as well as to low middle-class people. In 1980, 7% of Mexicans were obese, a figure that tripled to 20.3% by 2016, according to the Institute for Health Metrics and Evaluation at the University of Washington. Diabetes is now Mexico's top killer, claiming 80,000 lives a year, the World Health Organization (WHO) reported. Some experts consider that the North American Free Trade Agreement, enacted in 1994 by Mexico, Canada and the United States, could facilitate the free circulation of diet and food habits that would increasingly mirror those of the United States (with regard to the content of fats and sugar in foodstuffs and beverages). Such a phenomenon is not limited to Mexico. Research work has shown free trade is among key factors that have accelerated the spread of low-nutrient, highly processed food from the West, "driving the obesity epidemic in China, India and other developing countries worldwide," according to the T.H. Chan School of Public Health at Harvard University (Jacobs and Richtel, 2017b).

But Jaime Zabludovsky Kuper, Mexico's deputy chief negotiator on the NAFTA, stated this free-trade agreement did not cause obesity in Mexico. He stated that Mexicans had long been enticed by American food, and high tariffs used to make it expensive, not unavailable. But NAFTA, in addition to sharply lowering cross-border tariffs, let billions of dollars in direct foreign investment into Mexico; it fuelled the growth of American fast-food restaurants and convenience stores, and opened the gates to cheap maize,

meat, high fructose corn syrups (HFCS) and processed food. The surge in agricultural investment from the North modernized Mexican farming practices, but it also displaced nearly five million people who worked on family farms. Many migrated to towns, increasing the number of those who rely on processed food. The top two grocery chains and most of the top food-service outlets in Mexico are American-backed or partners with companies like Walmart, Subway and Pizza Hut. Oxxo, the convenience store chain, is owned by Femsa, a Mexican food and beverage conglomerate that has received hundreds of millions of dollars in foreign investment helping it to grow to 16,000 stores from 400 in 1990. Direct investments by the United States in Mexican food and beverage companies soared to US$10.2 billion in 2012 from US$2.3 billion in 1993, before the NAFTA was enacted (Jacobs and Richtel, 2017b).

In 2016, more than half of the agricultural products exported from Mexico to the United States were fruit, vegetables and juice, while these foods made up only 7% of what the United States exported to Mexico, according to the United States Department of Agriculture. United States exports to Mexico have been dominated by meat, soybeans and maize. The average annual value of grain crossing into Mexico jumped to US$4.7 billion in 2016 from US$897 million before NAFTA. Pork and beef exports also surged during the same period: exports of high fructose corn syrups reached US$345 million annually, from US$5 million. Duncan Wood, director of the Woodrow Wilson Center's Mexico Institute, stated falling prices of food, coupled with a stagnant economy, have left many Mexicans "to indulge in more processed food, consuming more calories, but not rich enough to have an affluent lifestyle where they are able to be healthier" (Jacobs and Richtel, 2017b).

A study published in 2015 found that Mexicans bought, on average, 1,928 kilocalories of packaged food and beverages a day, 380 more kilocalories than in the United States, and more than people in any other country tracked by Euromonitor International, a market research organization. While the causes of obesity are complex – involving genetics, lifestyle changes and food habits – multiple studies have linked weight gain to consumption of processed foods with high content of salts, sugar and fat (see Sasson, 2016). These are staples of retail giants. In 1991, as negotiators were designing the NAFTA's details, Walmart made its first foreign investment by partnering with Mexico's largest retailer, Cifra. In 1977, Walmart paid US$1.2 billion for a controlling stake in Cifra, and it is now Mexico's largest food retailer. Oxxo is second in grocery market share. It is also the largest convenience store chain, with a 75% market share, according to Euromonitor International. Although Oxxo is owned by the Mexican Femsa, it has significant outside investment. In 1993, Coca-Cola purchased one-third of Femsa's soft-drink unit for US$195 million, not long after PepsiCo had announced it would spend US$635 million to expand its business in Mexico. Then, in 1994, the Canadian brewing company Labatt invested US$510 million in Femsa's beer business. In its 2003 annual report, Femsa boasted that Oxxo had become "the largest vendor of beer and soft drinks, as well as telephone cards, cigarettes and bottled water." The chief financial officer of Femsa attributed Oxxo's growth to its aggressive corporate strategy, not free trade, though he conceded that outside investment gave Femsa a stronger financial footing to expand all its divisions, including Oxxo (Jacobs and Richtel, 2017b).

Despite some controversy about the role of NAFTA in Mexican diet transformation, there is evidence that those displaced from family farms to the suburbs of Mexican cities, as well as a significant number of people with limited income (at least 43% of Mexico's population lives in a state of poverty), are eating foodstuffs with a high content of salt, sugar and fat (flowing, to a large extent, from the United States). They are eating much less vegetables and fruits; which nevertheless are grown in Mexico that exports a lot of them to his American neighbour. Obesity in Mexico, particularly in children, has reached extraordinary figures and its relation with the new transformed diet cannot be denied, as well as diabetes occurrence. Efforts are made by the government (like a tax on sweetened drinks, and nutritional advice and recommendations) to reduce the health impact of this kind of "junk food." Non-governmental organizations also contribute to this effort, e.g. trying to show the nutritional advantages of traditional foods and cooking, when Mexican traditional cuisine was put on the UNESCO's List of World's Non-Physical Cultural Heritage by the mid-2000s.

Malaysia: alarming rate of obesity related to an unhealthy diet

Since 1990, Malaysia has become the fattest country in Asia, with nearly half the adult population now overweight or obese. Tee E. Siong, Malaysia's leading nutrition expert, organized a far-reaching study of local diets and lifestyle habits. The research conducted by scientists from the Nutrition Society of Malaysia, which Tee E. Siong heads, has produced several articles for peer-reviewed academic journals. Among the reviewers was Nestlé, the world's biggest food company, which financed the research. Among the published articles was one that concluded that children who drank malted breakfast beverages – containing Milo, a sugary powder drink made by Nestlé – were more likely to be physically active and spent less time in front of a computer or television set. This kind of nutrition research exemplified a deep financial partnership between the world's biggest food companies and nutrition scientists, policy-makers and academic societies – a practice that began in the West and moved to developing countries, along with rising obesity rates. The industry funds research projects, pays scholars consulting fees and sponsors most major nutrition conferences at a time when sales of processed food are soaring. In Malaysia, sales have increased 105% between 2012 and 2016, according to Euromonitor International (Fuller et al., 2017).

When corporate money influences nutrition science, Barry M. Popkin, a professor of nutrition at the University of North Carolina, stated, the evidence of what is healthy for people "gets obscured, gets confounded." In Malaysia, in addition to Nestlé, Tee E. Siong's work has been funded by American big corporations like Kellogg's and PepsiCo, and by Tate&Lyle, a British company that is one of the world's biggest makers of high fructose corn syrups, among others. He noted that traditional cuisine such as curries and other sugar-laden street food are key contributors to obesity, but that working with street vendors to make their food healthier is not easy. Working with multinational companies is easier and more productive, he stated. He said that he used his position in the government to impose a 2003 rule that required food companied to put nutritional information – the levels or contents of fat, sugar and protein – on their packaging. Tee E. Siong has mentioned that in a suburb of Kuala Lumpur the shelves of a supermarket were packed with products now found across the globe: instant noodles, spaghetti sauce, soda and rows of sugary cereals, including Nestlé's Stars,

which is 28% sugar and has a bright red circle on the bottom right of the box that says "Selected Healthier Choice, Malaysia Ministry of Health." He also stated: "Malaysians are always eating. They do not exercise" (Fuller et al., 2017).

Tee E. Siong was chairman of the committee on nutrition and health claims until 2011. In 2014, he created the Southeast Asian Public Health Nutrition Network (SEAPHN), with nutrition leaders from Thailand, Indonesia, the Philippines and Vietnam. Much of the network's funding came from Danone of France, Nestlé, PepsiCo and other big food companies. According to annual accounting reports, the nutrition society has received hundreds of thousands of dollars from industry, including US$188,000 from Nestlé and the Cereal Partners Worldwide – a joint venture of Nestlé and the American company General Mills – for the breakfast study. It has also received at least US$44,000 directly from Nestlé for other projects and collaborations; *ca*. US$11,000 from the dairy industry; US$10,000 from the Japanese company Ajinomoto, which makes aspartame; and at least US$40,000 from Philips Avent, the British-based baby and consumer products company, for projects related to infant and maternal nutrition. PepsiCo and Tate & Lyle have also sponsored the nutrition society's annual conference as well as Tee E. Siong's Southeast Asia Public Health Nutrition Network (Fuller et al., 2017).

Moreover, corporate partnership runs through a number of health initiatives in Malaysia. Thus a health ministry committee teamed up with the Federation of Malaysian Manufacturers, which includes representatives of major food companies, to develop a labeling system for the public. The labels inform consumers which packaged foods are a "healthier choice" than others in the same category. Among the products that obtained the label were children's sugar cereals and Gatorade Quiet Storm, which contains 12 g of sugar per serving (*ca*. four teaspoons) and is given a grade of D-minus for its nutritional value by Fooducate, an application that grades the heath of various foodstuffs, and won an award from the Surgeon General of the United States. The Malaysian health minister at that time stated the government job was not to be a watchdog over big food companies. "It is more cooperation," he said (Fuller et al., 2017).

But some nutritionists noted that Malaysia's dietary guidelines were not as strict on sugar as they might otherwise be. These guidelines recommend to people to load up on grains and cereals, and to limit fat to less than 20% or 30% of daily kilocalories, a recommendation which was removed from dietary guidelines in the United States in 2015 after evidence emerged that low-fat diets do not curb obesity and many contribute to it. Corporate funding of nutrition studies in Malaysia has weakened the case against sugar and processed food, stated Rohana Abdul Jalil, a Harvard-trained diet expert based in the rural State of Kelantan, where obesity was as high as in the biggest cities. She was working in Kota Bharu, the State's capital, where vendors set up food stalls outside schools, selling cups of soda from big plastic bottles, as well as chocolates and puffed corn and rice snacks flavoured with squid, shrimp and cheese. Rohana Abdul Jalil, who did not take research money from food companies, was promoting a campaign back to basics: whole grain rice and other natural foodstuffs that are native to Malaysia. She criticized the research papers that came out of the nutrition society's breakfast study. Tee E. Siong and his colleagues published a study that pointed to breakfast cereals, which are not part of the traditional Malaysian diet, as an "important source of nutrients," although the same study also pointed to high

sugar levels in the cereals. David Ludwig, a Harvard nutrition expert, stated about the study: "There is no reason that supplemental nutrients need to come in the form of a sugary beverage, especially for low-income population at risk of obesity." Tee E. Siong still considered that the obesity risk in Malaysia would be worse without food companies' help, and that he could not accomplish his goals without their support (Fuller et al., 2017).

The Malaysian story underlines once again the load of sugar and fats in the diet of people, which does not exclude traditional cuisine (e.g. chicken curry meals) and which contributes to the high rate of obesity in this country. The dietary guidelines are sometimes biased through the interference of food companies towards processed food and sugary beverages. Nutritionists are not always able to resist this influence because the nutrition studies are often financed by the food companies themselves (see pp. 74-77). We need nevertheless independent nutrition research carried out by scientists, the government and competent NGOs, so as to draw useful dietary recommendations to promote healthy food habits. Malaysia is rich in natural resources and a diet based on vegetables, fruits, and animal or legume-based protein, as well as a low percentage of fats, is within the reach of Malaysian people. Falling in the trap of the so-called "junk food", sometimes since childhood, is not a fatality. There are ways to avoid falling in that trap and to curb obesity through a healthy behaviour toward food and beverage consumption.

China: nutrition policy and the role of soft-drink companies

The Chinese efforts that emphasized exercise as the best way to lose weight and struggle against the rise of obesity, did not in fact mention the importance of cutting back on the calorie-laden junk food and sugary beverages that have become ubiquitous in the world's second largest economy. In the late 1990s, the International Life Sciences Institute (ILSI), through which operated multinational food and soft-drink companies, organized obesity conferences and paid the way of Chinese scientists who attended the events; it helped create national health campaigns aimed at tackling the country's obesity epidemic, according to Susan Greenhalgh, a social scientist and China expert at the Department of Anthropology, Harvard University (Greenhalgh, 2019a, b).

China's public health initiatives almost always promote exercise, but they seldom mention the value of cutting calories or reducing the consumption of processed food and sugar-sweetened beverages, which many nutritionists state is essential for losing weight, keeping it off and improving health. The ILSI is a worldwide organization with headquarters in Washington, D.C., funded by many of the biggest names in snack food, including Nestlé, McDonald's, PepsiCo and Yum Brands, as well as Coca-Cola. It has 17 branches, most of them in emerging countries like Brazil, India, Mexico and South Africa, and promotes itself as a bridge between scientists, governments and multinational food companies. But in China, the ILSI is so well placed that it runs its operations from inside the government's Center for Disease Control and Prevention in Beijing. The ILSI's director, Chen Junshi, stated his organization always emphasized the importance of both exercise and a well-balanced diet, and that its activities "are based on science, and are not affected by any business" (Jacobs, 2019).

However, Barry Popkin, a professor of nutrition at the University of North Carolina, Chapel Hill, who was not involved in the above-mentioned studies, has spent decades working in China to help the country develop nutrition guidelines and food policy – efforts he said that were often thwarted by well-placed officials aligned with the ILSI. Given his experience, S. Greenhalgh's findings were not surprising. "Over the course of several decades, Coca-Cola and ILSI have worked to prevent any kind of food policy that would benefit public health," he stated. In fact, Coca-Cola tried similar tactics in the United States by partnering with influential scientists and creating a non-profit Global Energy Balance Network (GEBN) to promote a message that exercise, not dieting, was the solution to the nation's obesity crisis. But in 2015, after an article in *The New York Times* and the efforts and subsequent outcry from public-health advocates, the company disbanded the network (Jacobs, 2019).

In China, the ILSI made the following statement: "ILSI does not profess to have been perfect in our 40-year history … Not surprisingly there have been bumps along the way. This is why ILSI has analyzed best practices and has committed to ensuring scientific integrity in nutrition and food-sector research." Coca-Cola stated that it had also been changing the way it funded scientific research through greater transparency and by ending its practice of providing the lion's share of money for studies. In recent years, Coca-Cola added that it has addressed mounting obesity in China by offering an array of new sugar-free beverages and through improved nutrition labelling on products." We recognize that too much sugar is not good for anyone," it said (Jacobs, 2019).

It is true that in just a few decades China has gone from a nation plagued by food shortages to one buffeted by soaring obesity and chronic diseases tied to poor diet. More than 42% of adults in China are overweight and obese, according to Chinese researchers, more than double the rate in 1991. In Chinese cities nearly a fifth of all children are obese, according to government surveys. These increases closely follow growing wealth in China that began in the 1980s as Beijing embraced market economics after decades of isolation. In 1978, Coca-Cola was among the first companies allowed into the country, and the ILSI was created soon afterward. This group found a partner in Chen Chunming, a leading nutritionist who was the founding president of the Chinese Academy for Preventive Medicine, the forerunner of China's Center for Disease Control and Prevention. In 1993, Chen Chunming became the head of ILSI-China and she remained a senior adviser to the organization until her death in 2018 (Jacobs, 2019).

With sweetened-beverage consumption dropping in the United States and Europe, Coca-Cola increasingly viewed China and other developing countries as primary markets to maintaining its profits. China has become the company's third-largest market. Martin McKee, professor of European public health at the London School of Hygiene and Tropical Medicine, stated such groups (like ILSI) often claim to be independent think-tanks but refuse to disclose detailed information about their funding. These groups, he added, support and publicize scientific studies whose results sometimes avoid contentious issues like smoking or alcohol and soda consumption (Jacobs, 2019). It therefore seems unavoidable that China's fitness-is-best message would have to be twisted in order to take account of these new findings; it should underscore that in addition to exercise, a good nutrition policy should also be focused on how to thwart a poor or unbalanced diet, associated with obesity and diet-related illnesses like type 2 diabetes and hypertension. See also Stuckler, Ruskin and McKee (2018).

Diabetes surge

In 2018, China had an estimated 116 million diabetics, by far the highest number of any country. By the end of the 20th century it had fewer than 25 million. This dramatic surge, almost entirely involving type 2 diabetes, worries the government. A big reason for the increase is that as people became richer they often consume more processed food and sugary drinks. One in seven Chinese adults is obese, including a quarter of adults in Beijing, China's fattest city. The urban share of the population has grown from less than 20% to about 60% since 1980. City dwellers tend to be less physically active than people in rural areas. There may be a genetic link, too. Research has found that ethnic-Han Chinese are acquiring type 2 diabetes while younger and thinner than Caucasians. Smoking is another factor. China has one-fifth of the world's population but consumes one-third of its cigarettes. The most recent national survey, in 2013, found that nearly 65% of China's diabetics were unaware of their condition (in the United States it is about 25%). Only *ca*. one-third were having treatment. Among those receiving it, only *ca*. half were keeping their blood-sugar levels within a healthy range (*The Economist*, 2019c).

In recent years the number of people with state health-insurance has grown hugely. This has reduced out-of-pocket spending on health from 60% of the total in 2001 to around 30% in 2018. It has made more affordable for many diabetics to receive the treatment they need. But the government's insurance still does not cover some essentials, such as blood-sugar test strips and injection devices. In July 2019, the government published a list of priorities for health-care reform in the coming decade. They include a pledge to improve support for diabetics. Many people do not have easy access to family doctors or specialist nurses, who are best able to provide the kind of regular advice and check-ups that type 2 diabetes patients need. Even if they do, Chinese patients often prefer to use big-city hospitals, believing that specialists there will do a better job because of their greater expertise. Such hospitals account for *ca*. 55% of health-care spending in China, compared with less than 40% in rich countries. Building a primary-care structure that patients trust will require enormous effort, including finding physicians willing to work as general practitioners (who have fewer money-earning opportunities than hospital doctors) and devising better incentives for GPS to promote preventive measures, such as healthy diets and physical exercise (*The Economist*, 2019c).

According to *The Economist* (2019c), without an overhaul, China's health-care system will be crushed by the burden of coping with the chronic diseases that will burgeon as the population ages. In recent years annual increases of total health-care spending have been 5-10 percentage points higher than GDP growth. About 13% of China's health spending goes toward treating diabetes, and perhaps four-fifths of that is spent treating complications that could be avoided. It is obvious that gradual changes should be brought to food-eating and drinking habits (emphasizing healthier diets) as well as to lifestyle (more physical exercise).

Renewed fierce competition among soft-drink companies

Consumers across the world are increasingly advised to drastically reduce their consumption of sugar-sweetened beverages, which are closely associated with "junk food." The industry still produces huge volumes of sodas and soft drinks, with all the relevant advertisements. Nevertheless, there is a trend for choosing healthier products, more natural and produced by small companies or craftsmen. Thus, in the United States for instance, water is more consumed: in 2016, for the first time, Americans have bought more bottled water than sodas. According to Euromonitor International, the market of bottled water, supported by the American trend, had an annual average growth rate of 6.2% between 2012 and 2018; it is now valued at more than US$210 billion or €182 billion (Girard, 2018c).

In this rough battle over sodas and bottled water, the big giants such as PepsiCo and Coca-Cola adopt a new strategic approach: to buy smaller companies which produce bottled water. Thus PepsiCo bought the Israelian company Sodastream for US$3.2 billion or €2.8 billion. This was a big surprise, because Sodastream severely criticized in its advertisements Coca-Cola relentlessly and PepsiCo, denouncing the use of plastic bottles. Sodastream has been proposing to the consumers to make their own sprinkling water, with aroma or without, just by putting gas into tapwater; Sodastream was also behind the new fashion to consume Seltz water. Nevertheless, the Atlanta-based Coca-Cola was ahead of PepsiCo: the latter was, in terms of volume and with 3.2% of the world market in 2017, in the fourth position, behind the trio including Danone (7.6% of the market), Nestlé (6.9%) and Coca-Cola (5.5%). In terms of value, Coca-Cola is the world's top company with 8.4% of sales of bottled water, followed by Nestlé (8.3%), Danone (7%) and PepsiCo (2.9%) [Girard, 2018c].

The acquisition of Sodastream by PepsiCo was announced when PepsiCo's chief executive officer (CEO), Indra Nooyi, who was to be replaced on 3 October 2018 by Ramon Laguarta. Coca-Cola also changed its CEO, Muhtar Kent (CEO since 2008) by James Quincey. Similar changes did occur for Mondelez's CEO Irene Rosenfield who stepped down and was replaced by Dirk Van de Put (Mondelez is a food company producing sugary and chocolate biscuits). At the head of Campbell Soup, Denise Morrison has been replaced by Keith McLoughlin as acting CEO. Kellogg's, the big producer of cereals for breakfast, is now chaired by Steve Cabillane instead of John Bryant. General Mills, renowned for its ice-creams Häagen Dazs, also replaced its CEO Ken Powell by Jeff Harmening. This movement also occurred in Europe: Nestlé had to seek Ulf Mark Schneider – a non-agrifood specialist, but a health manager – to replace Paul Bulcke. In France, the transition at the head of Danone – the world's leader in yogurt production – took place on 1 December 2018 with the nomination of Emmanuel Faber as CEO (Franck Riboud remains as president of the group, delivering the executive role to E. Faber). All these movements at the top of the world's biggest food and beverage companies reflect the need for adaptation to the changes in the eating habits of the consumers, increasingly concerned about their nutrition and health. They also need to be more prepared to face the very rapid changes in the distribution of goods, with the irruption of the American Amazon and the Chinese Alibaba. In addition, the competitive pressure among the companies leads to acquisitions and mergers, such as those noticed in the case of PepsiCo and Coca-Cola, respectively (Girard, 2018b).

Coming back to Coca-Cola, the Atlanta-based company had bought Glacian in 2007 for US$4.1 billion; since then it had in its portfolio the sugary and coloured Vitaminwater beverages (their commercialization in France has been a failure). It also acquired a more successful water brand, Smartwater. On the European market, Coca-Cola had acquired the Belgian brand Chaudfontaine; thereafter, in 2008, a bottling company of spring water at Morpeth (in the north of England) – the bottled water was sold under the brand Abbey Well. It is on that site that Coca-Cola produces its Smartwater for the European consumers. Before being bottled, the water, which comes in two versions, still and sprinkling, is sterilized by an industrial process and mineral salts are added later on with a view to controlling the taste of the final beverage. In 2018, the price of Smartwater in Europe was €1.5 for a 600-ml bottle (Girard, 2018c).

PepsiCo reacted through the commercialization of Aquafina, a bottled purified tapwater, with the clear aim to market it in the United States, Canada, India, Lebanon, Spain and other countries. Moreover, in 2017, to counter the success of Smartwater, PepsiCo commercialized LifeWTR, purified water with mineral salts added. The beverage company was trying to attract the so-called "millennials", i.e. people between 18 and 36 years of age, who want to buy healthier food, with less sugar, and are increasingly tempted by organic or even vegan food. But the battle between PepsiCo and Coca-Cola is also over bubbling or sprinkling waters, of which the profits are higher. After Coca-Cola bought the Mexican trendy brand Topo Chico by the end of 2017, PepsiCo commercialized Bubbly, bottled in colourful cans, for the United States market in 2018 (Girard, 2018c).

Coca-Cola pursued its diversification strategy, in order to find out alternative solutions to the decrease in consumption of the main brands of sweetened beverages. Consumers want to drink healthier beverages and are therefore demanding new and more natural drinks. Henceforth the need to be present on the market of bottled water, ice tea and even milky beverages. This strategy seems to work: in 2017, Coca-Cola's annual turnover reached US$35.4 billion or €30 billion. Although this figure was 15% less than in 2017, because of selling-bottling factories, it showed in fact a 3% increase, in constant exchange rate. Just after the new CEO of Coca-Cola had been appointed in 2017 (James Quincey), the company announced the acquisition of a trendy beverage in the United States, called Moxie soda. By mid-August 2018, it took a minority equity in the capital of BodyArmor – energizing drinks. On 31 August 2018, Coca-Cola announced the acquisition of Costa coffee company for €4.3 billion. Created in London in 1971, this company had in 2018 2,400 selling sites in the United Kingdom and another 1,400 across the world, not to speak about the 8,000 coffee machines installed in supermarkets and petrol stations. The acquisition of this international brand enables Coca-Cola to have another expertise in the supply of coffee and to face the competition from other giants, such as Nestlé or Starbucks, on an ebullient market (Girard, 2018d).

These competitors are changing the rules of the game. For instance, the investment fund JAB of the German Reimann family founded the Benckiser group, which became Reckitt Benckiser and had a participation in the cosmetic group Coty, before launching

a fierce battle in the agrifood business in 2012. With the help of JAB it quickly created a coffee empire, while buying such chains as Peet's Coffee & Tea, Caribou Coffee or Panera, and building up Jacobs Douwe Egberts (JDE), the world's leading coffee group, in terms volume. Nestlé remains the world's leader in terms of value. Moreover, JAB has increased its pressure on Nestlé through the acquisition of Keurig Green Mountain; the American company specialized in the manufacture of coffee capsules that compete with Nespresso. Nestlé reacted by making an alliance with Starbucks with a view to commercializing coffee under this brand across the world. JAB took also part in the confrontation between Coca-Cola and PepsiCo: in January 2018, it bought the American company Dr Pepper Snapple Group, the third-biggest producer of sodas in the United States, just behind Coca-Cola and PepsiCo. But Coca-Cola with the purchase of Costa is ready to compete with its new rival on its turf (Girard, 2018d).

On the other hand, the Japanese group Suntory has launched a new brand of less-sweetened beverage with a view to meeting the French consumers' wish to drink beverages with less sugar. O'Verger was the new brand of the group Orangina Suntory; it was part of its flagship brand Oasis. Bertrand Delmas who has been appointed as the chief executive officer (CEO) in 2018 of Orangina Suntory recalled the results of a recent poll among French people that showed 80% of the interviewed persons made a close association between food intake and health, and 30% of them tried to drink less sweetened beverages or products. According to Orangina Suntory, the new beverage O'Verger contained 4.2 to 4.4 grams of sugar per 100 ml; this sugar was derived from concentrated fruit juice mixed with spring water. That concentration of sugar was similar to that of Pulco Fines Bulles, commercialized in 2018, and close to that of May Tea, a tea-based beverage, successfully marketed in 2016. In the case of Oasis Tropical, the common beverage of Orangina Suntory, 100 ml contain 7.1g of sugar, even though this concentration has been reduced by 25% since 2006. This change was even more drastic in the case of Schweppes: the concentration of sugar dropped, from 10.2 g to 6 g over the same period, i.e. a 41% reduction. However, in the case of Orangina, the early brand of the company, sugar concentration is still about 9.6 g per 100 ml. The beverage group was also trying to progressively eliminate dyes, artificial aromas and preservatives in its beverages, in addition to lowering sugar content (Girard, 2019e).

This strategy led to a 10% increase in the volumes of beverages sold in 2018, with an annual turnover of €926 million. It was expected that another €100 million would be earned in terms of annual turnover thanks to the commercialization of the new beverage O'Verger over three years. Orange Suntory benefits from the French people's lesser attraction regarding colas drinks, the sales of which have been reduced by 291 million liters over five years (77 million liters in 2018), according to the consulting firm Nielsen. The decision made by Orangina Suntory was directly hitting Coca-Cola, which was applying a diversification policy (see above) and decided, for the first time in its history, to purchase a French brand in 2018 – Tropico, a fruit still beverage. That was meant to thwart the expansion of Orangina. Tropico initially has a sugar concentration of 12 g per 100 ml, but another version with only 8g of sugar per 100 ml has been commercialized in May 2019 (Girard, 2019e).

To sum up, the rivalry among soft-drink companies continues to be tough across the world, not only to conquer new markets or increase their market share, but also to diversify and adapt their business to the consumers' requests for much less sweetened and healthier beverages (e.g. water in different forms, and even coffee or tea). A large proportion, however, of the soft-drink industry is still devoted to the production of sugar-sweetened beverages that are consumed by a wide range of low or middle-income consumers. These beverages and the excess sugar they bring in the diet intake are associated to a large extent with the so-called "junk food." Consequently, not only more educational efforts should be made by the governments and their nutritionists, but also by the beverage industry for its own sustainable development, in order to change consumers' eating and drinking habits.

Could a multinational corporation influence science?

A devastating enquiry

In 2015, by the end of summer, *The New York Times* published an article that drastically hit the reputation of Coca-Cola. The American daily newspaper revealed the involvement of the soft-drink multinational in the coordination and funding of a Global Energy Balance Network GEBN (see p. 69). For several years this organization has been relying on scientists in positions of influence that were disseminating a "solution" to the global obesity epidemic through articles published in medical journals, participating in conferences and social networks. The message of these experts can be summarized as follows: "Do more exercise without taking care too much about reducing your calorie intake." Such a message was at the opposite of public health specialists, because it was omitting the role of food intake and highlighting only the lack of physical exercise. The sad reality was that a 33-centiliter can of a soft drink, with a caramel-like colour, contains the calorie equivalent of seven lumps of sugar (535 grams). *The New York Times'* article created a scandal in the United States. In addition to dismantling the GEBN, Coca-Cola's chief executive officer (CEO) had to commit the company to candidly publish the kinds of funding provided by his firm. On the web site of the latter were published the names of several hundreds of experts working for the company as well as the list of activities funded in the United States since the beginning of the decade: US$21.8 million or €19.4 million, allocated to research projects and US$96.8 million devoted to partnerships. These informations were made public in several countries. In France, thanks to the perseverance of the NGO Foodwatch, Coca-Cola had to publish these lists in April 2016. These data, once updated, were examined by the French daily newspaper *Le Monde*. The findings were that, since 2010, Coca-Cola had distributed more than €8 million to experts and several medical associations, but also various meetings and sport events. In France, like elsewhere, these fundings were to a large extent related to sponsoring and communication, and not to real scientific work (Horel, 2019).

An amazing list of experts

Coca-Cola explained that its fundings "helped in assisting the drafting of pamphlets, or in managing some of its stands during congresses, or even in enabling the participation of speakers in symposia." But the company did not give more details, and it stated

that this kind of collaboration came to an end in 2016. Indeed its tables showed a clear-cut decrease in this kind of generosity after 2016, as well as its commitment to have more transparency. It is true that the lack of detailed information by the company does not apply to France only. In 2018, social and public-policy scientists have been analyzing the bulk of data published by Coca-Cola across the world, on the basis of the multinational's commitment to more transparency. They compared them with the studies published in scientific journals that clearly mentioned a funding by the Coca-Cola Company or the Coca-Cola Foundation, its philanthropic arm. The end result was that out of 389 articles published in 169 journals and signed by 907 authors at least, the firm quoted only 42, i.e. less than 5%. Despite Coca-Cola's promises for more transparency about the funding of scientific work, several researchers concluded in an article published in the *European Journal of Public Health* that "Coca-Cola funding of scientific research lacked transparency" (Matos Serodio, McKee, Cohen and Stuckler, 2016). Such opacity also applied to the analysis of the much longer list of "the activities in the fields of nutrition and physical exercise" that Coca-Cola was funding in France – a total amount of €7.8 million (Horel, 2019).

Sponsoring of conferences

Also in France the "partnerships" of Coca-Cola consisted, to a large extent, of sponsoring conferences attended by health professionals. For instance, the annual Dietecom fair received more than €140,000 between 2010 and 2017. The French Exercise and Sport Medicine Society received *ca*. €80,000 between 2010 and 2016 in the framework of "an annual partnership with the beverage brand Powerade." The Bichat Symposia (*Entretiens de Bichat*), an important encounter of physicians in Fance, received a total amount of €100,000. Thèrèse Libert, vice-president of the French Association of Dietician Nutritionists, explained that the €135,000 received by the association between 2010 and 2018 have been allocated to purchasing a stand (space) where the multinational could advertise its products during the annual congress of the association. That was also the case of "70 to 80 brands, such as the salads Florette or Lipton," she stated. But no information about this kind of sponsoring was found on the website of the association, according to the enquiry carried out by *Le Monde*'s journalists (Horel, 2019).

Costly research projects

Finally more than one-third of Coca-Cola's fundings was allocated to three costly "research" projects, totalling €2.4 million. The largest amount of money has been received by CreaBio for implementing "a research project on intense sweeteners" in 2014-2015. The bill amounted to more than €900,000. In 2019, CreaBio was bankrupt after having been a commercial company whose annual turnover in 2016 amounted to more than €500,000. According to this study carried out on 170 individuals and whose conclusions were published only in 2018, there was no difference between the intake of water and that of beverages containing "low-calorie sweeteners", with regard to the impact on "appetite, energy intake and food choices". Regarding conflicts of interest, Marc Fantino, the founder of CreaBio, has received additional fees, because he was "a member of the consultative committee and the bureau of speakers" of the International Sweeteners Association – a lobbying organization of which Coca-Cola is a member along with other suppliers of sweeteners (Horel, 2019).

The second target of Coca-Cola in terms of research funding was the Institute for European Expertise in Physiology (IEEP), which received *ca*. €720,000 over the period 2010-2014, in order to carry out another "research project on intense sweeteners." The results were published once again after an unusually long delay, in 2018, and the main conclusion was that there was no impact of consumption of sweetened beverages on the sensitivity to insulin or on the secretion of this hormone which regulates the concentration of glucose in the bloodstream. The endocrinologist Fabrice Bonnet was the main researcher involved in this project carried out at the University Hospital (CHU, French acronym) of Rennes (Brettany, northwest of France); he stated that Coca-Cola looked at the conclusions of the study and did not deny that its results belonged to the multinational. He was surprised by the amount of money allocated to the project and claimed by the company. The study carried out did, according to him, include 60 individuals and had cost between €200,000 and €300,000. The French daily newspaper *Le Monde* which was conducting the enquiry revealed that behind the Institute for European Expertise in Physiology, which acted as a go-between Coca-Cola and the CHU, was hidden a commercial society that had a 2014 turnover of €1.3 million. The company had at its helm Frédéric Saldmann, a cardiologist and nutritionist at the Georges-Pompidou European Hospital, in Paris. He was also an entrepreneur and one of his companies, led by his wife and called Sprim, was specialized in "strategy consulting and health communication." Coca-Cola did not hide to *Le Monde* that it was a client of Sprim, which organizes every year the congress Dietecom; the multinational had participated between 2010 to 2016 to the congress through symposia or through the purchase of a stand displaying its products (Horel, 2019).

The last beneficiary of a "research" funding by Coca-Cola was the International Prevention Research Institute (IPRI) that is ubicated in the vicinity of Lyon and which received €690,000 in 2012-2013 for "a research project on the consumption of sugars". "Of the IPRI list of publications one article has been supported by Coca-Cola's funding. It was published in 2014 in the *European Journal of Cancer Prevention* (Boyle et al., 2014). Peter Boyle, the main author of the article, explained that the funding allocated by Coca-Cola also included a meta-analysis and review on an association between sweetened and carbonated beverage consumption (including colas) and cancer. Peter Boyle of the University of Strathclyde Institute of Global Public Health, United Kingdom, who was at that time the president of the IPRI and his co-authors, Alice Koechlin (University of Strathclyde Institute of Global Public Health) and Philippe Autier of both institutions, aimed to examine the assumption or speculation on an association between sweetened, carbonated beverage consumption and cancer risk. Over 50 independent estimates of risk were available, 11 for colas specifically. A random-effects meta-analysis was carried out. Boyle et al. (2014) found that over all the different sites of cancer, the summary relative risk (SRR), when all 55 independent estimates were considered together, was SRR=1.03 [95% confidence interval (0.96; 1.11)]. When individual cancer sites were considered, there was no significant increase or decrease in the meta-analysis estimate of risk cancer of the pancreas, bladder, kidney, squamous cell or adenocarcinoma of the oesophagus, colon, gastric cardia, gastric noncardia, prostate, breast, larynx and ovary or of the oral cavity, pharynx or glioma. There was no evidence in a sensitivity analysis from these studies that

reported results separately for colas of an associated risk of pancreas cancer [SRR=1.0, 95% confidence interval (0.61; 1.65)]. The results of all other forms of cancers were considerably hampered by poor methodology and small numbers of studies. Overall, the findings of Boyle et al. (2014) were reassuring in terms of the association between soft drinks, including colas, and cancer risk, although the quality of many of the studies was quite poor by acceptable and modern standards.

Interference with the results of sponsored research

In 2019, a study was published that showed that *Coca-Cola* had the right to forbid the publication of any result of a research work it had sponsored, if this result were not agreeable with it. That was contrary to the multinational's public commitments. Since the end of the 2000s, because of the accumulation of data indicating the serious drawbacks of soft-drink consumption, Coca-Cola made the decision to launch a vast programme aimed at funding scientific activities and studies. Conducted by Sarah Steele, a professor of law and public health at the Jesus College of the University of Cambridge (United Kingdom), the above-mentioned study consisted of scrutinizing five contracts signed between Coca-Cola and American and Canadian university researchers. As summarized by S. Steele, the multinational "had the right to interrupt research contracts, without giving any justification." But, "the terms and conditions of these contracts were not consistent with the statements made by Coca-Cola on its Internet website" (Horel, 2019).

By the end of the 2015, due to public opinion pressure, the multinational had in fact made a series of commitments concerning the scientific work it sponsors. In particular, it has stated that from now on the researchers working in the framework of a contract signed with the multinational must have "the complete mastering of the design of the study, the implementation of the latter, the recollection of the data, their analysis and interpretation." It also certified that the multinational had not the right, under any condition, "to forbid the publication of any study's results." However, the meticulous analysis of these contracts had been made possible thanks to the American NGO US Right to Know. Its director, Gary Ruskin, had made some 130 requests, in order to have access to the relevant documents, in a dozen universities and public entities in the United States and elsewhere. He had been able to assemble about 87,000 pages of documents. Among the latter he found five contracts with the mention "confidential", along with the relevant correspondence. These five contracts do not contain any explicit directives or instructions regarding the discussion of the results to be obtained. In fact there are a lot sutleties and clauses about the implementation of all research steps that could imply some kind of censorship. According to Sarah Steele, Coca-Cola is in fact implementing a kind of "soft control", or "soft power". "It has the power to influence, to make comments and to interrupt." In the case of the contract with the University of Louisiana, it was stated that " the sponsor will not give its opinion on the contents of a scientific article, but it has the right to review it and to make comments." That means, according to Sarah Steele and her colleagues, that Coca-Cola "has the right to put an end to the study at any time and without real grounds (…) if the conclusions of the study do not comply with its interests." (Horel, 2019).

Following an interview with *Le Monde* about the compliance with the principles stated in 2016, Coca-Cola insisted on the fact that it has been pursuing "the process with a view to becoming a more useful and efficient partner in combating the major problem of obesity across the world. "Sarah Steele and her colleagues have come to the following conclusion: the journals which publish these studies should mention the sources of funding as well as the conflict-of-interest statements; and therefore they should "demand the provision by the authors of their funding contracts" (Horel, 2019).

Health risks

Deschasaux et al. and Touvier (2018) carried out a prospective analysis that included 471,495 adults from the European Prospective Investigation into Cancer and Nutrition (EPIC, 1992-2014), among whom there were 49,794 incident cancer cases (breast, prostate and colon-rectum). Usual food intakes were assessed with standardized country-specific diet assessment methods. The British Food Standards Agency (modified version) – Nutrient Profiling System (FSAm-NPS) was calculated for each food/beverage using their 100 g content in energy, sugar, saturated fatty acids, sodium, fibers, proteins, and fruit/vegetables/legumes/nuts. The FSAm-NPS scores of all food items usually consumed by a participant were averaged to obtain the individual FSAm-NPS Dietary index (DI) scores. A higher FSAm-NPS DI score, reflecting a lower nutritional quality of the food consumed, was associated with a higher risk of total cancer. Absolute cancer rates in those with high and low FSAm-NPS DI scores were 81.4 and 69.5 cases/10,000 person-years, respectively. Higher FSAm-NPS DI scores were specifically associated with higher risks of cancers of the colon-rectum, upper aerodigestive tract and stomach, lung for men, and liver and postmenopausal breast for women. The main study limitation is that it was based on an observational cohort using self-reported dietary data obtained through a single baseline food frequency questionnaire. However, in this large multinational European cohort (EPIC), it was found that the consumption of food products with a higher FSAm-NPS score (i.e. lower nutritional quality) was associated with a higher risk of cancer. These findings add support to the relevance of using the FSAm-NPS to grade the nutritional quality of foodstuffs as a basis for prevention strategies for cancer and other chronic diseases. These findings will play a role in communications about the merits of the Nutri-Score to consumers, health-care professionals and economic operators, in the context of the ongoing European/international debate on nutritional labeling (Deschasaux et al. and Touvier, 2018).

It should be recalled that the British Food Standards Agency (modified version) Nutrient Profiling System (FSAm-NPS) was the basis of a similar nutrient profiling system, called Nutri-Score, which was adopted in France in 2017, Belgium in 2018 and Germany in 2019. Nutri-Score aims to evaluate on a coloured scale (from green to dark orange) and with letters from A (some kinds of pasta, mashed potatoes, juices, etc.) to E (some biscuits, cornflakes, etc.), the foodstuff nutritional qualities and thus to label the well-balanced foods (Santi, 2018a).

Mathilde Touvier, who coordinated the prospective analysis with Mélanie Deschasaux, are members of the research team on nutritional epidemiology (French National Institute for Health and Medical Research – INSERM; University of Paris-XIII; National Agricultural Research Institute – INRA; and the National Arts and Crafts Centre, CNAM), which worked in partnership with the International Agency (Centre) for Research on Cancer (IARC-CIRC, WHO, Lyon, France). The team highlighted that there seems to be a consensus about the impact of the consumption of junk food (too fatty, salty, sweetened and ultra-processed foodstuffs) on the risk of developing a cancer as well as of other chronic diseases. Reducing the consumption of this kind of foodstuffs is one of the key messages of the World Health Organization (WHO), which for many years has been warning against the risks of obesity and overweight (Santi, 2018a).

Serge Hercberg, which chaired the French National Nutrition and Health Programme, of nutritional scores, especially Nutri-Score." However, in 2019, there are six big multinational food companies which do not accept the validity of Nutri-Score: Nestlé, Coca-Cola, PepsiCo, Mars, Mondelez and Unilever. While *ca*. fifty food-distribution companies have started to use Nutri-Score in their supermarkets (Nutri-Score was not yet mandatory by the end of 2018), the "Big Six" have proposed their own system, called the Evolved Nutrition Label. Their calculation was not based on the score for 100 g, but on a portion size, which gives a score that varies from one person to another (Santi; 2018a). Egnell et al. and Hercberg (2018) have studied the impact of the European Union three coloured Front-of Pack labels (FoPLs) – two endorsed by governments (Nutri-Score and Multiple Traffic Lights or MTL) and one designed by the industry (Evolved Nutrition Label or ENL – on portion size selection, specifically for less healthy products. In 2018, more than 20,000 participants from the French NutriNet-Santé cohort study were exposed through a web-based self-administered questionnaire to products from three food categories (sweet biscuits, cheeses and sweet spreads), with or without FoPLs; they were invited to select the portion they would consume (in size and number). The researchers found that compared with no label, Nutri-Score consistently lowered portion sizes, followed by MTL. For ENL, the effects differed depending on the food groups: it lowered portion size selection for cheeses and increased it for spreads. Therefore, Nutri-Score, followed by MTL, seemed to be efficient tools to encourage consumers to decrease their portion size for less healthy products, while ENL appeared to have inconsistent effects depending on the food category (Egnell et al. and Hercberg, 2018).

In this context, on 20 November 2018, Nestlé announced that it abandoned the Front-of-Pack label Evolved Nutritional Label (ENL) which was also supported by Coca-Cola, PepsiCo, Mondelez and Unilever (Mars had withdrawn in March 2018). In a press release, the five big multinationals had to acknowledge the lack of support for their proposal. They nevertheless highlighted that studies could be pursued on the segment of beverages if Coca-Cola would like to carry out more work. Nestlé had forecast to test the ENL in Spain, Portugal, Poland, Greece, Belgium and Cyprus. But the consumers' associations and the health authorities have denounced this food label, because it was not based on the content of fat, salt and sugar per 100 g (Nutri-Score basis), but per portion size, which could be defined by each agrifood and

beverage company as the right food intake. For instance, in the European Prospective Investigation into Cancer and Nutrition (EPIC) study mentioned earlier, the researchers demonstrated that the same spread or paste could have a red Nutri-Score with an E, while using the ENL it was labeled yellow or green. It was therefore concluded that the ENL "had a very limited effect, most likely unfavourable among the consumers regarding the sizes of the portions selected for foodstuffs which are considered as less healthy" (Egnell et al. and Hercberg, 2018; Girard, 2018j).

When Mars left the "Big Six" in March 2018, the number of companies or enterprises willing to adopt the Nutri-Score label reached 70, some of them following the steps of pioneers like Danone and the French Bonduelle and Fleury-Michon companies. Distribution brands also followed suit regarding the products sold under their name. Finally, after France (2017), Belgium (2018) and Germany (2019) chose to adopt the Nutri-Score label (Italy was opposed), Nestlé was ready for the next battle: "We call on the European Commission to pursue the discussions at the European level in order to develop a nutritional label system, to be stuck on the food package, and which would lead to a harmonized solution," highlighted Bart Vandewaetere, in charge of communication and relations with the governments at Nestlé Europe. "We must be very clear regarding the list of ingredients contained in our products," added Mark Ulf Schneider, chief executive officer of Nestlé. The Swiss food giant recalled the work already done and aimed to reduce the contents of sugar, fat and salt in its products. He mentioned that Nestlé will reduce by 5% the sugar content of the products sold in Europe by 2020, i.e. a total of 18,000 tons. Nestlé is planning to use a product of its research-and-development work: "a porous crystalized sugar" which reduces by 30% the sugar content in a foodstuff without changing its taste. As a first commercial application of this innovation, Nestlé launched a new chocolate bar in the United Kingdom under the brand Milkybar Wowsomes (Girard, 2018j).

Nutritional yardsticks for public health in France

On 26 September 2018, at the French parliament (National Assembly), an investigation committee adopted its report on industrial food and health impacts after six months of work and *ca*. forty audits. Such a review aimed to warn consumers about junk foods. For that purpose, the composition of foodstuffs has been screened in order to reduce the number of additives authorized in the industrial processing of food: from 338 authorized nowadays to 48 by 2025, which is the number of additives authorized in organic food. The industrialists were also advised to reduce the contents of contaminants and residues in foodstuffs and in food containers. The report strongly condemned the presence of ''newly grown'' (neoplastic) compounds in children's food (Santi, 2018a).

As a number of studies (such as those mentioned above) have correlated the consumption of ultra-processed and industrially transformed foodstuffs with the risk of developing a cancer, the committee proposed that advertisements concerning children's food be restrained, as well as the mandatory setting up of the Nutri-Score system for processed or ultra-processed foodstuffs, and also the indication of food provenance. Another proposal of the committee was about the consumption of salt.

"The World Health Organization (WHO) recommends a consumption of 5 g of salt per day and per person, while nowadays the average consumption is between 10 g and 12 g," explained in August 2018 the member of parliament in charge of the committee's report. The committee also wanted to limit the content of salt in bakery products (18 g per kg of flour), because *ca*. 30% of daily salt intake is provided by bread in France. A suggestion made by the committee concerned fines to be paid by those who do not respect the authorized content of salt. It seems that the French agriculture ministry was willing to establish charts of good practices with the industrialists, with a view to decreasing the sugar, salt and fat contents of their processed products, rather than adopting constraining measures (Santi, 2018b).

The French parliamentarians also wanted to improve the conditions of institutional catering through a stronger reliance on organic agrifood production, in school dining halls, elderly homes, health-care centres; and also to reduce food wastage. Finally, the committee's report underlined the need for a deep change in food governance in France, as well as for the measures aimed at struggling against social inequalities; because, as explained in the report, "the persons who have less resources are those who suffer from obesity" (Santi, 2018b). The French parliament voted a law on agriculture and food (Food Bill) at the beginning of November 2018. Regarding the chapter of the law devoted to food, the NGOs and the *Confédération paysanne* (Farmers' Confederation) expressed their satisfaction concerning the objective of a content of 20% of organic products in institutional catering in 2022; bearing in mind that the government intended to increase the acreage of organic farms in France, from 6.5% to 15% of total cultivated area in 2022. Greenpeace, as well as associations for animal well-being, expressed their high satisfaction about experimentally introducing a vegan meal per week in institutional catering (Girard, 2018e).

On 22 January 2019, *Santé publique France* (SPF, Public Health France) presented its new recommendations on food, physical exercise and sedentarity of adults, based on an earlier report of the National Agency for the Sanitary Safety of Food, Environment and Work (ANSES, French acronym for *Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail*). That report was based on the scientific data collected over the last ten years. Also these new recommendations were related to the report of the High Council for Public Health (*Haut Conseil de la Santé publique*). As explained by Anne-Juliette Serry, in charge of the Unit for Food and Physical Activity at SPF, "Our role has been to interpret these scientific data with a view to achieving simplified recommendations, that can be accepted by the French population. In addition, these recommendations include, for the first time, the environment issue." In this regard, it is suggested to eat organic products, *seasonal* fruit and vegetables, *locally produced*.

These new recommendations, indeed, are easy to understand and to implement, they are practical and accessible. They aim to help the populations to make the best food choices and to adopt physical exercise. To design its recommendations *Santé Publique France* has relied on the expertise of a committee including health-care specialists, epidemiologists, health-prevention and promotion experts, information-and-communication professionals, as well as those who daily work with the populations. Qualitative and

quantitative studies targeting the large public and professionals have allowed the adjustment of the recommendations during the whole process of designing them. The new recommendations combined the simplicity for the largest number of people, as well as the precision for those who want to do more. They are divided into three categories that can be summarized as follows: Increase, Heading for and Reduce. Among the novelties proposed one could find the importance given to legumes, nuts, non-processed starchy products, the promotion of simplified Nutri-Score labeling as well as the need to take into account the impact of food habits on the environment. Regarding physical exercises the recommendations proposed to enhance it and to reduce the time of being seated during the day. Some of the recommendations are detailed as follows.

The well-known slogan "Eat at least five fruits and vegetables per day" (about 400 grams) was still valid. The French people do not consume these ingredients in sufficient quantities. The recommendation was therefore "to increase, even slightly, the vegetables and fruits eaten, because it is good for health." They can be fresh, frozen or preserved. It was also suggested to eat at least twice a week legumes, such as lentils, chickpeas, beans, etc., which are not often present in the French people's meals. These are rich in fibers and proteins. Another new recommendation referred to consuming every day a small-handful of nuts (almonds, walnuts, hazelnuts), which are rich in omega-3 fatty acids. Also in order to increase the consumption of fibers – that is now less than the recommended 25-30 g per day – it was suggested to eat a complete starchy food every day and to preferably consume cereals such as bread, flour, rice and pasta, that are not ultra-processed (Santi, 2019a).

Meat consumption should not exceed 500 g per week (i.e. three to four steaks equivalent) and poultry should be preferred compared with other meats. Charcuterie consumption must not exceed 150 g per week (equivalent to three ham slices). With respect to fish, SPF recommended that it should be consumed twice a week, one fish being a fatty species, such as sardines, salmon or herring. It is worth mentioning that some fish species could contain pollutants, such as heavy metals; the provenance of the fish is therefore important to watch. It was also expected that the intake of fatty, salted and sweet, ultra-processed foodstuffs, should be limited, or drastically decreased, because the consumption of cereals, pastries and precooked meals was rising too fast. In fact, the limitation concerns any industrially processed foodstuff, containing pigments, preservatives, aromas and other additives. Anne-Juliette Serry explained: "As a precautionary measure, it is suggested to choose foodstuffs that are additive-free and to preferably cook almost raw products; this could apply to canned beans or frozen fish" (Santi, 2019a).

Regarding sweetened beverages, it was recommended to limit the daily intake to only one of them. Water should be drunk instead (in particular tap water when it is safe). Sugar consumption is too high in France. With respect to dairy products, two per day are recommended (e.g. yogurt or grated cheese on pasta) and not three. Finally, regarding fats, it was recommended to choose olive, canola or walnut oils. Salt intake must be reduced. The intake of alcoholic beverages – the cause of 49,000 deaths annually in France – should be drastically decreased: two glasses of

wine per day (instead of three formerly) or a dozen glasses per week. Moreover, SPF recommended to pregnant women to abstain from drinking any alcoholic beverage. All these messages that aimed to reach the large public, are in fact "a small revolution", according to Serge Hercberg, a member of the SPF working group. These messages were disseminated by the health authorities through information campaigns in 2019, and physical exercise, for at least 30 minutes per day, was not omitted, because it is an important aspect of a healthy lifestyle (Santi, 2019a).

Health risks of ultra-processed foodstuffs (or "fake food")

Researchers and nutritionist physicians have recently focused their attention on the health risks of the so-called "fake food" or "adulterated food". These are industrially transformed or ultra-processed foodstuffs. This kind of transformation that started a dozen years ago, has been publicized by the Brazilian researcher Carlos Monteiro, a nutrition professor at the University of São Paulo. He designed a classification called NOVA which defines the four stages of processing or industrial transformation of foodstuffs and serves as a reference. If it is true that whatever we eat is transformed – this transformation or processing is the basis of cooking and gastronomy – the ultra-processed foodstuffs are the result of an industrial deconstruction of raw foodstuffs, with the addition of numerous ingredients. According to the NOVA classification, group 1 includes raw products, of plant or animal origin, that could be peeled, washed and cut into pieces, cooked or frozen; the nutritional properties of these foodstuffs are not altered. Group 2 of the classification includes cooking ingredients such as oils, sugar, salt, or fatty substances obtained by exerting pressure, centrifugation, refining or extraction. Group 3 includes foodstuffs, processed through a combination of products belonging to group 1 and 2, e.g. a wide range of breads, cheeses and craft-cooked meats. Group 4 includes ultra-processed foodstuffs, which are thereafter recomposed and to which are added food additives (Gérard and Santi, 2019).

A marker that helps recognize ultra-processed foodstuffs is the presence of ingredients that are not generally found in a kitchen such as maltodextrine – a saccharide derived from the hydrolysis of starch or potato starch –, hydrolyzed proteins (taste enhancers) or caseinates (emulsifiers and texture enhancers derived from milk proteins), among others. They include breakfast cereals, cookies, snacks, take-away meals, preserved sauces, packaged buns, sweetened and aroma-flavoured beverages, dehydrated soups, any kind of processed product containing additives besides salt. Also one can add the foodstuffs containing pigments, sweeteners, emulsifiers and other food additives. Canned vegetables with salt added belong to the first or second group of the NOVA classification, whereas pan-fried vegetables with a ready-made sauce containing taste-enhancers, texturizing substances, or bleaching compounds are part of the ultra-processed foodstuffs (Gérard and Santi, 2019; Santi, 2019b).

The latter can make up 50% of the energy intake in such countries as Canada and the United States. According to Matthieu Allez, a medical doctor, head of the department of gastroenterology at the Paris Saint-Louis Hospital, our food has been profoundly modified during the last 50 years; many substances contained in this modern food intake, such as emulsifiers, pesticides, endocrinal-disruptive compounds, could have a

harmful effect on the intestinal microbiote. We do not know the effect of the association of all these compounds, i.e. the so-called "cocktail effect". For instance, two emulsifiers, the carboxymethylcellulose or cellulosic gum (E466) and the polysorbate 80 (E433), seem to disrupt the intestine lining and thus alter the barrier against microbes, and later on causing inflammation.

Chassaing et al. (2015) of the Georgia State University (Atlanta) Center for Inflammation, Immunity and Infection of the Institute for Biomedical Sciences, the Bar-Ilan University (Safed, Israel) Faculty of Medicine, Cornell University (Ithaca, New York State) Department of Molecular Biology and Genetics, and Emory University School of Medicine (Atlanta) Digestive Diseases Division of the Department of Medicine, have studied the impact of dietary emulsifiers on the mouse gut microbiota. It had been hypothesized that emulsifiers, detergent-like molecules that are a ubiquitous component of processed foods and that can increase bacterial translocation across epithelia *in vitro*, might be promoting the increase in inflammatory bowel disease observed since the mid-twentieth century. Chassaing et al. (2015) reported that, in mice, relatively low concentrations of two commonly used emulsifiers, namely carboxymethylcellulose and polysorbate-80, induced low-grade inflammation and obesity/metabolic syndrome in wild-type hosts and promoted robust colitis in mice predisposed to this disorder. Emulsifier-induced metabolic syndrome was associated with microbiota encroachment, altered species composition and increased pro-inflammatory potential. Use of germ-free mice and faecal transplants indicated that such changes in microbiota were necessary and sufficient for both low-grade inflammation and metabolic syndrome. These results support the emerging concept that perturbed host-microbiota interactions resulting in low-grade inflammation can promote adiposity and its associated metabolic effects. Moreover, they suggest that the broad use of emulsifying agents might be contributing to an increased societal incidence of obesity metabolic syndrome and other chronic inflammatory diseases (Chassaing et al, 2015). It seems that these emulsifiers were not often withdrawn from food processing. Some 4,000 emulsifiers exist in ultra-processed foodstuffs; it is almost impossible to study all of them, and, what is even more difficult, to evaluate their combined impact. On the other hand, M. Allez, a physician, does recommend that, to the largest extent possible, one should cook his/her food, choose good quality products, with an emphasis on those of plant origin. It is also recommended to choose fruits and vegetables when they ripen at the right season, and to buy them locally. A vegetable that is imported over large distances probably contains preserving compounds and other additives in order to facilitate its transport (Santi, 2019c).

Nutritional studies and the evaluation of the health risk

As ultra-processed foodstuffs are present in the various components of the food intake, they are being studied by nutritionists and physicians, in particular regarding their impact on health. Their distribution in food intake is the following: 28% in sweetened products (e.g. chocolate bars), 18% in fruits and vegetables (e.g. industrial preparation), 16% in beverages (sodas and soft drinks), 12% in breakfast cereals and starchy foodstuffs, 11% in meat, fish and eggs (cooked and cured meat), 8% in dairy products (e.g. milk desserts), 5% in sauces (e.g. margerine) and 2% in salted snacks (Gérard and Santi, 2019).

A French Nutritional Epidemiology Research Team (EREN), including the National Institute for Health and Medical Research (INSERM), the National Agricultural Research Institute (INRA), the University of Paris-XIII and the National Conservatory of Arts and Crafts (CNAM), have conducted a study to assess the prospective associations between the consumption of ultra-processed foodstuffs and the risk of cardiovascular diseases (Srour et al., 2019). The survey has been carried out on the NutriNet-Santé cohort, which is a large-scale public-health study conducted on-line and concerning adult volunteers who are periodically interviewed about their food and health. Among 105,159 participants that have been monitored between 2009 and 2018, the researchers noticed that an intake of ultra-processed food was associated with a higher risk of overall cardiovascular disease (1,409 cases; hazard ratio for an absolute increment of 10 in the percentage of ultra-processed foods in the diet), coronary-heart and cerebrovascular diseases. These results took into account the socio-demographic factors and the lifestyle of the participants in the survey, such as age, level of instruction and knowledge, tobacco smoking, consumption of alcoholic beverages and exercise. The persons targeted by the study were more than 45 years old, 73% of them being women. Ultra-processed foodstuffs reached a proportion of 14.4 % in their consumption (in terms of grams of food ingested) and of 29% of total energy intake (Srour et al., 2019).

This study, which cannot yet demonstrate the close relationship between ultra-processed food consumption and the risk of illness, has in fact some statistical biases: women are overrepresented in the monitored cohort and the participants had healthier eating habits than the average consumer. However, the researchers concluded that the correlation between the consumption of ultra-processed foodstuffs and cardiovascular diseases is probably higher than in the general population. Mathilde Touvier, EREN's director, stated that we are dealing with an observation study, which deserves more research. She added nevertheless "more and more studies conclude that there is a correlation between the consumption of ultra-processed food and health risks. This echoes the previous findings on the risk of cancer and irritable-colon syndrome, associated with the intake of this kind of foodstuffs; it also echoes the work of international teams regarding the occurrence of hypertension and obesity associated with the intake of this kind of food" (Srour et al., 2019; Santi, 2019b; Gérard and Santi, 2019). The same research team (EREN) had previously shown that there was a significant statistical relationship between the consumption of ultra-processed foodstuffs and the occurrence of cancer, especially breast cancer – a 10% increase in the proportion of this kind of foodstuff intake was associated with a 12% rise in global cancer risk (Fiolet et al., 2018).

A team of researchers of the American Institutes of Health – NIH (Diabetes and Digestive and Kidney Diseases; Health Clinical Center; Nursing Research), Bethesda, Maryland, and of the Singapore Institute for Clinical Sciences, have investigated whether ultra-processed foods affect energy intake in 20 weight-stable adults, aged 31.2±1.6 years and Body Mass Index 27±1.5 kg/m^2. Subjects were admitted to the NIH Clinical Center and randomized to receive either ultra-processed or unprocessed diets for two weeks immediately followed by the alternate diet for two weeks. Meals were designed to be matched for presented calories, energy density, macronutrients, sugar, sodium and fiber. Subjects were instructed to consume as much or as little as

desired. Energy intake was greater during the ultra-processed diet (508±106 kcal/day), with increased consumption of carbohydrates (280±54 kcal/day) and fat (230±53 kcal/day), but not protein (2±12 kcal/day). Weight changes were highly correlated with energy intake, with participants gaining 0.9±0.3 kg during the ultra-processed diet and losing 0.9±0.3 kg during the unprocessed diet. Therefore, limiting consumption of ultra-processed foods may be an effective strategy for obesity prevention and treatment (Hall et al., 2019).

In 2019, 338 food additives were authorized in Europe. However, the report of the French parliamentary committee on industrial food and health impacts (see p. 80) has suggested to lower this number down to 48 in 2025, i.e. the number of additives authorized in organic food in 2019. Some additives, such as titanium dioxide, have been classified as "probably carcinogenic for humans" by the International Agency (Centre) for Research on Cancer (IARC-CIRC, French acronym for *Centre international de recherche sur le cancer*, Lyon, France).

Reinforcement of the nutritional labeling of foodstuffs

According to Louis-Georges Soler, deputy-scientific director of the INRA, "the development of ultra-processed foodstuffs has coincided with a decrease in the variety of raw agricultural produce and, conversely, with an amazing increase in the variety of products derived from the assembling possibilities" (e.g. one type of milk, but hundreds of yogurt preparations), he added. For instance, a dehydrated soup "with seven green vegetables" contains in one packet (or sachet) the following ingredients: a) those derived from food cracking – maize starch, glucose syrup, antioxidant, acidifying compounds, milk proteins, emulsifiers, modified starch potato and aromatic compounds; b) true ingredients and compounds derived from refining – parsley, chervil, skimmed milk, wheat flour, powdered butter, palm oil and salt. The soup therefore contains 49% of added foodstuffs (to serve as taste enhancers, texture improvers, etc.) and 51% of vegetables, including 12,9% of green vegetables. Anthony Fardey also explained that in the second decade of the 21st century, "we are going through a nutritional transition, which coincides with an amazing increase of chronic diseases and the stagnation of life expectancy in good health." In his book titled in French *Halte aux aliments ultratransformés*! *Mangeons vrai* (Stop to Ultra-Processed Foodstuffs! Let Us Eat Right, Thierry Souccar ed., 2017. A. Fardet describes the industrial food-processing techniques, borrowing his words from the petrochemical-sector vocabulary, e.g. the word *cracking*. "This means the fractionation of the structure of a foodstuff in order to isolate its basic ingredients and thereafter to reassemble them with a view to amplifying the flavour and savour of the final products." In fact there is a small number of raw materials that could be fractionated: wheat, rice, egg, potato, milk, peas, meats (Gérard and Santi, 2019).

The fractionation process could modify the health benefit of the foodstuff, stated also A. Fardet. For instance, "the almond, if it is entire or ground up, it will have the same composition, but not the same effects at the level of lipid metabolism. The error made over the last 50 years was that we focused on the composition of foodstuffs, and not on their matrix. What we put in our mouth are not just carbohydrates or lipids, but

complex foodstuffs the nutrients of which are later on released in the body." There are several assumptions to explain the impact of these ultra-processed foodstuffs on health. Firstly, they do not have a good nutritional composition, with more fats, sugars and salt than raw food. Secondly, there are too many food additives, some of which have been considered as "probably carcinogenic." There is finally the issue of a cocktail effect, which has not been evaluated by the European Food Safety Authority (EFSA). Another assumption concerns the possible creation of neoformed molecules during the ultra-processing of food. Also, there may be a risk of translocation of plastic components from the food package to the foodstuff matrix, according to Mathilde Touvier, the EREN's director (Gérard and Santi, 2019).

In France, the new recommendations issued on 22 January 2019 by Santé Publique France (SPF) emphasized the need to limit the intake of ultra-processed foodstuffs and, conversely, the preference for raw or slightly-processed food (see p. 87). These recommendations were in tune with the High Public Health Council's objective to reduce by 20% the consumption of this kind of foodstuffs by 2022. The ultra-processing of food has been discussed in many scientific journals and in the media, and it has been increasingly criticized. For instance, in April 2019, eight members of the French Agriculture Academy criticized the classification NOVA (see above) which is, in their view, scientifically "overestimated" or even "non legitimate." The opinion of these scientists is not necessarily that of the Academy. Meanwhile, some food retailers are seizing this opportunity to reduce the content of additives in their food products. For instance, in 2017, the French group Casino has evaluated 1,500 products and defined a new obligation framework: no more than three additives per recipe and no more than one additive belonging to a broad category, e.g. pigments, taste enhancers, preserving compounds. In 2019, one-third of the range of products has been reviewed. This example shows that the list of food additives can and must be reduced, especially in children's foodstuffs: cereals, chocolate bars, confectionery, liquid yogurt with several aromas, cheese specialties. It is therefore not surprising that in this context, Australian researchers have requested public authorities to set up a nutritional labeling on the package of foodstuffs, such as Nutri-Score, and to restrain the marketing and advertisement of unhealthy products. This is a very sensitive issue, because attempts to forbid the marketing of children's foodstuffs have often failed, for instance in France (Gérard and Santi, 2019).

Are unhealthy diets killing more people than smoking?

The conclusions of a study carried out by 130 researchers, working in the framework of the Global Burden of Diseases (GBD) Injuries, and Risk Factors, and under the Institute for Health Metrics and Evaluation (IHME, Seattle, Washington State, United States), have been published by Afshin et al. (2019). It should be recalled that the relationship between dietary habits and chronic non-communicable diseases (NCDs) has been extensively investigated. Long-term randomized trials with NCD endpoints have not been feasible for most dietary factors, but synthesis of other lines of epidemiological evidence, including long-term prospective observational studies and short-term trials of intermediate outcomes, have provided supporting evidence for potential causal relationships between specific dietary factors (e.g. fruit, vegetables, processed meat

and trans-fat intake) and NCDs (ischaemic heart disease, diabetes and colorectal cancer). These findings have been widely used in national and international dietary guidelines, aimed at preventing NCDs. However, because of the complexities of characterizing dietary consumption across different nations, assessment of the health effects of suboptimal diets at the population level has not been possible (Afshin et al. 2019).

Since the year 2010 or even before, efforts have been made to quantify the burden of disease attributable to specific dietary factors. These efforts, although useful, had several important limitations, including insufficient geographically representative data on dietary consumption, inaccurate characterization of population distribution of dietary intake, insufficient accounting for biases of different sources of dietary assessment, standardization of the intake to 2,000 kcal per day, and insufficient accounting for within-person variation of intake of dietary factors. To address these limitations, as part of the Global Burden of Diseases, Injuries and Risk Factors Study (GBD) 2017, Afshin et al. (2019) have systematically collected geographically representative dietary data from multiple sources, characterized the population distribution of intake for 15 foods and nutrients among adults aged 25 years or older across 195 countries, estimated the effect of each individual dietary factor on NCD mortality, and quantified the overall impact of poor dietary habits on NCD mortality. They also evaluated the relationship between diet and socioeconomic development, and assessed the trends in disease burden of diet over time. This analysis supersedes all previous results from GBD with respect to dietary risks by comprehensively reanalyzing all data from 1990 to 2017, using consistent methods and definitions (Afshin et al., 2019).

With the support and funding from the Bill and Melinda Gates Foundation, Afshin et al. (2019) have estimated the proportion of disease-specific burden attributable to each dietary risk factor, using a comparative risk assessment approach, among adults aged 25 years or older. The main inputs to this analysis included the intake of each diet, the effect size of the dietary factor on disease endpoint, and the level of intake associated with the lowest risk of mortality. Thereafter they calculated the number of deaths and disability-adjusted life-years (DALYs) attributable to diet for each disease outcome. The findings of the study can be summarized as follows: In 2017, 11 million deaths and 255 million DALYs were attributable to dietary risk factors. High intake of sodium (3 million deaths and 70 million DALYs), low intake of whole grains (3 million deaths and 82 million DALYs) and low intake of fruit (2 million deaths and 65 million DALYs) were the leading dietary risk factors for deaths and DALYs globally in many countries (Afshin et al., 2019).

To sum up, this study provides a comprehensive picture of consumption of 15 dietary factors across nations and quantifies the potential impact of suboptimal intake of each diet component on chronic disease mortality and morbidity among 195 countries. Additionally, this study characterizes the relationship between diet and development and evaluates the trends in the burden of disease attributable to diet from 1990 to 2017. High intake of sodium, low intake of whole grains and low intake of fruit were the leading dietary risk factors for deaths and DALYs globally and in many countries. Therefore, the study highlights the need for improving diet at the global, regional and national level (Afshin et al., 2019).

While the United Nations launched in 2016 "an action decade for nutrition," the above-mentioned study confirmed that more efforts should be made in the area of public health. Francesco Branca, director of the nutrition department of the World Health Organization (WHO), warned: "The conclusions of this study are an alarming signal; if we do not follow a healthy diet, both for our health and environment, we will not go very far." In fact, there is "a worldwide awareness of the major impact of nutrition on chronic diseases," and "nutrition is not a subsidiary issue as this was perhaps understood twenty years ago," stated Mathilde Touvier, a research director at the French National Institute for Health and Medical Research (INSERM), who participated in the above-mentioned study (Benkimoun and Gérard, 2019).

This study showed that no country across the world is unscathed from the impact of unhealthy diets. Not a single region out of the 21 large geographic areas surveyed did present in 2017 an optimal consumption of the 15 foodstuff ingredients listed, although a few of them achieved this goal: for instance, Central Asia for vegetables, the wealthy countries of Asia and the Pacific region (Japan, South Korea) for omega-3 fatty acids, and the Caribbean, South Asia and sub-Saharan Africa for legumes. Poor countries are severely hit by the risks relating to unhealthy diets. Mortality rate associated with food diets is ten times higher in Uzbekistan (892 deaths per 100,000 inhabitants) than in Israel (89 deaths per 100,000); this country has the lowest mortality rate, followed by France, Spain and Japan. "While many populations do not have the purchasing power to buy fresh fruit and vegetables, and consume too much fatty, salted and sweetened products, the situation in France is relatively satisfactory," explained M. Touvier. "But there is still room for improvement," she added. Sixty per cent of French people eat less than five portions of fruit and vegetables a day and 38% of them eat less than one dairy product a day. By contrast, 30% of French people consume more than 500 g of red meat per week and 40% of them consume more than 150 g of processed meats per week; these figures are far beyond the official dietary recommendations (Benkimoun and Gérard, 2019).

Although the study carried out in the framework of the GBD was not dealing with undernutrition or obesity – two facets of malnutrition – Francesco Branca of the WHO thinks that the response to the food crises should not just focus on the gross calorie intake, but on maintaining a sufficient fruit-and-vegetable production in all regions of the world. An additional focus is to make the prices of foodstuffs affordable. "Up to now policies have tried to convince consumers to change their food behaviour, but we must work on the supply side," explained F. Branca. The GBD team extended their study in close cooperation with the WHO, with a view to evaluating the combined impact of the whole range of nutritional problems, i.e. malnutrition, overweight and obesity, quality of food and undernutrition. The results of this complex study were expected in 2020 (Benkimoun and Gérard, 2019). We may find out at that stage if unhealthy diets are killing more people than smoking.

FAST FOOD AND STREET FOOD: FACTS, FASHIONS, BIG BUSINESSES AND THEIR FORESEEABLE STRATEGIES

A worldwide wave

Across the world and for many decades now, people have been increasingly attracted by the fast-food way of having a quick and cheap snack, any time during the day; lunching and dining; taking the wrapped meal or receiving it at home or at the office. The recipes are numerous: from the American burger to the French sandwich or to the Turkish döner kebab, all kinds of pizza and variations of local cuisine sold in stalls along the streets or in food trucks. Fast food has been associated with junk food, but the business is adapting its strategies to suit consumers' tastes and their wish to eat healthy food that is not costly and delivered on the spot or rapidly. Fast food indeed is part of our hectic life and fast-food companies are everywhere: names such as McDonald's, KFC (Kentucky Fried Chicken), Burger King, Quick, and many more, are at the same time symbols and very big businesses. Similar standards regarding food variety, presentation, serving and delivery apply everywhere, so that customers feel familiar with their environment wherever they are in the world.

In France, for instance, the wave of fast food has been spreading in a country renowned for its gastronomy and famous chefs. Since the opening of the first McDo in the Halles square in Strasbourg in 1979, the number of fast-food restaurants under this banner has reached more than 1,285 in 2018, compared with 1,500 sushi restaurants and 11,000 shops selling kebabs (see below). France is the second most profitable country for McDonald's, behind the United States, and also it is in France where the growth rate is highest. The yellow M of McDo is everywhere across the country because of a dense network which now includes small towns (around 2,000 inhabitants). In 2018, *ca.* 2 million meals were served by McDonald's, every day across France, a figure which is not very far from the 2.2 million buttered sandwich with ham which are delivered daily to French consumers – this is by far the usual sandwich preferred by French people, especially by those with a small or medium income (Foucher, 2018). The French market of fast food has increased by 2.5% in 2016 to reach €18.7 billion. McDonald's' American rival Burger King is growing rapidly through the purchase of the Quick brand, with a view to owning 600 Burger-King restaurants in France by the end of 2020 (Girard, 2017b).

How to explain the fact that France, a country renowned for its culinary tradition throughout the world, has become such a big market for fast food and in particular for McDonald's? What happened in this country when in 2018 trade unions in Marseille (south-east of France) have been fighting against the foreseen closure of a McDo in the

northern boroughs of France's second-largest town? McDo, which may be a French passion, is in fact a wonderful product imagined and designed by two marketing geniuses at McDonald's France: Denis Hennequin and Jean-Pierre Petit, who strongly suggested a "frenchization" of the brand at the beginning of the 2000s. Instead of the yellow M on a red background, there is now a green background, a service at the consumer's table, a better interior design and even a range of sandwiches garnished with Roquefort cheese and beef from the Charolais breed (Foucher, 2018).

Lorraine de Foucher, a French journalist who made an enquiry about the presence of McDos in small towns or in rural areas, interviewed the mayor of a village of 600 people in the Lozère region (south of France), where a total of 70,000 people were living in 2018, who stated that the McDo, opened in 2012, had replaced the former café which had disappeared; the present McDo attracts people living at *ca*. 30 km across the countryside. L. de Foucher was therefore wondering whether McDonald's has become the new café of the French village. She quotes the following enlightening statistics: in 1960 there were *ca*. 200,000 cafés in France, compared with *ca*. 32,000 nowadays; in 1960, consuming a meal took about one hour and 38 minutes (average), compared with 31 minutes today. McDo may thus be considered the new village café, "but it is not anymore located in the main square of the village, but rather at the periphery; it needs space for parking lots and a playground for the children, and it also needs the passing-by road in order to have a regular flow of consumers," commented Bernard Boutboul, a specialist of fast food and director-general of the consulting firm Gira Conseil. Hélène Weber, a psychologist who lives in a small village, has published a book titled *Du Ketchup dans les veines* (Ketchup in the Veins, Eres Editions, 2005), where she describes the process of change regarding local consumption. "By contrast to a village café, where you have to talk to people and where you do not know what you are going to eat, McDo's purpose is not to make people feel less lonely. It is an enterprise with economic objectives. When you feel hungry, you just go to the McDo, it is easy, fast and you are full, but two hours later you are not feeling well and you are hungry again. Regarding the McDo's social role, it is the same, i.e. fast food and fast sociability," stated Foucher (2018).

Another reason for the success of the McDo in the small or medium-sized towns is its opening or working hours. It is sometimes the only place to have dinner after 21 hours. Everybody is welcome because there is no other place opened, and it is fast and does not cost too much, about €10 per person (average). Bernard Boutboul explained: "McDo is the last place to be opened, it's the place where you can be sure to find something to eat anytime, whereas the usual restaurants close earlier because they do not have the staff that can stay over long hours. They have lost the battle of working hours" (Foucher, 2018).

Global success of the sandwich

The sandwich was born in the city of Sandwich, in the Kent area of England. In 1762, Sir John Montagu, the fourth earl of Sandwich, Admiral of the Fleet of King George III of England, and very fond of gambling, was playing cards in a pub and the game party was unusually long. The chef of the pub was concerned about interrupting Sir

John and therefore prepared for him a light meal: cold meat and cheese between two slices of bread. This snack enabled the Admiral of the Fleet to nibble at it without staining his fingers. At that time, bridge did not exist, so the Admiral played whist. His friends ordered the same snack as the earl of Sandwich. Since then, the very common snack has been called a sandwich. This could have been different if the Admiral would have preferred to bear the title of earl of Portsmouth, following the example of his ancestor, the first earl of Portsmouth, Edward Montagu. But he decided to bear the name of Sandwich, the city where was sheltered the fleet of which he was in command in 1660 – the year when Charles II came back to England after nine years of exile in France. The story does not end there. James Cook, the great seafarer and discoverer of so many territories, admired Sir John Montagu who was three times the first Lord Admiral during his lengthy career, particularly during the war in America; during his exploration of the Pacific, he decided to give the name of "Sandwich islands" to two archipelagos he discovered (these are today the Hawaii Islands). These islands were his last residence: James Cook was: murdered by the Hawaiians on the 14th of February 1779, when he was sailing out for his third expedition, trying to find the Northwest Passage … (Grué, 2012).

Regarding the future of the sandwich, it has been a global wave over the last 250 years, and in England the 11th earl of Sandwich has opened in 2012 a fast-food restaurant with the help of his son Orlando and gave it the name of Earl of Sandwich (Grué, 2012). There is such a wide range of sandwiches, but always the same basic pattern: to put between two slices of bread food ingredients such as cheese; grilled vegetables seasoned with a dash of olive oil; two kinds of ham; mozzarella-tomatoes and basil; ham-turkey-beef and cheddar in a club sandwich; mackerel-tuna-eel with avocado, lemon and wasabi; apple and rocket (aragula); Brie cheese with apple and cranberry, etc.

The bagel belongs to the same family as the sandwich: it is part of New-York culinary heritage. Central Europe Jews had imported the recipe with them at the end of the 19th century. A new generation of cooks and bakers are giving to this small ring of dough its original crispy taste. In 2014, three new spaces have been opened in Manhattan's Lower East Side in the area of the bagel golden age: Baz, Black Seed, Russ and Daughters' Café. It should be recalled that since the 17th century the Central-European Jewish Ashkenazi community had adopted the bagel; the latter travelled to North America with the the first migration wave, taking root, for instance, among the Jews settling in New York or Montreal. The bagel remained in both cities until the 1950s; at that time, a polish immigrant, Harry Lender, developed a freezing technique that facilitated the massive delivery of the bagel. After this trend of industrialization of the bagel by Harry Lender, craftsmanship returned with Melissa Weller, a chemical engineer, who started to make bagels in 2006, "as a hobby". She was working at that time at one of the trendiest restaurants in Manhattan, Per Se, and she made the decision to serve bagels for the breakfast of the team of cooks. Thereafter she devoted all her career to the bagel, first educating people attending the Smorgasborg market in Brooklyn; then preparing the inauguration of a specialized café in 2015. The New York press had christened her "the missionary of the bagels." Some cooks, like Noah Bernamoff from Quebec, preceded Melissa Weller, and served at Black Seed Bagels a hybrid bagel (New York and Montreal) consisting of salted dough cooked over charcoal (Chayet, 2014).

Amazing success of the kebab

Berlin is considered the world's capital of the döner kebab (literally revolving stewer), or more simply kebab, a sandwich filled with meat roasted on a skewer and generally garnished with French fries and a mixture of salad, tomato and onions. There are at least *ca*. 1,300 restaurants or shops selling kebab in that city (*ca*. 16,000 across Germany). Cécile Boutelet (2016) mentions that in the district of Kreuzberg, the restaurant Mustafas Gemüse Kebap has been nicknamed "the better döner of the world". People used to queue up for a quarter of an hour in front of a simple bungalow to buy the sandwich for about €4. Many of the people waiting for their fast food are tourists. There are other reasons why Berlin has restaurants that serve the best döner kebab; for instance, the restaurant Imren in NeuKölln, near Hermannplatz, is a traditional Turkish restaurant, the clients of which are either Germans or Turks – this minority has migrated to Germany four decades ago and its population amounts to more than 5 million people, a large part of it has acquired the German nationality, but maintains tight relationships with Turkey (Boutelet, 2016).

The reputation of the German döner extends far beyond Germany. It has become an export product and the local industry supplies *ca*. 80% of the European market, i.e. *ca*. 800 tons of meat, according to the data of an association of producers (ATDID). Some 250 suppliers and vendors of that kind of sandwich had an annual turnover of *ca*. €3.5 billion. But despite its undeniable success, the döner was hit by the tainted-meat scandals in 2006 and 2007. Since then a quality label has been developed, and it is awarded after the claimant's participation in a seminar on the hygiene, preparation and conditions of sale of the döner. A döner fair was even held annually until 2012 (Boutelet, 2016). As explained by Benjamin Baudis in his booklet, published in 2018 (*Kebab, question döner*, Orient Ed.), the person really fond of kebab is above all a shrewd and risk-taker who first "appreciates the hygiene of the restaurant or of the food stand, who checks the skewer and who hesitates between choosing the white or Algerian sauce," before starting a tasteful experience (Hemme, 2019).

In France, the kebab success fostered the interest of a journalist, Jérôme Porier, working for the daily newspaper *Le Monde* (2016). He made his enquiry in Paris and its wider region – Ile de France – in 2016. At that time, the kebab was called a "Greek" sandwich, and a "note of €20 could buy four "greeks." In the north of Paris (17th district), there are about a dozen of kebab shops, some of them existing since 2001, attended by school teenagers several times a week; but there are many more clients who appreciate the loafs of meat roasted on a revolving skewer and made of veal and turkey (lamb is too expensive). Every kebab restaurant seems to have its recipe for preparing the meat loaf. One of them quoted by *Le Monde*'s journalist is: "to add paprika, garlic, olive oil, thyme, lemon juice and milk to the meat." The customers can choose between various kebab versions, and J. Porier (2016) quotes one of these customers, that seems to reflect a wide-ranging opinion: "The greek is less costly than a McDo burger or a bread sandwich, and it makes you feel full; for a price of €6.50 we have a complete sandwich with a mixture of salad, tomato and onion, and a soft drink, this is unbeatable!"

The outstanding success of the kebab in France is due to the fact that it attracts around the same skewer blue and white collars, students and seniors, non-believers or Muslims if the restaurant has a halal certification. But his attraction has been shattered over recent years by the so-called new-kebabs who tended to flourish. Besides high-end addresses, kebabs that do not serve meat have also opened their doors. For instance, at Chez Janine Loves Sunday, in the second district of Paris, or at Super Vegan, in the 17th district, the seitan, a protein-rich product made from wheat or spelt flour, replaces the meat which is generally at the core of the preparation. The result is a generous ration, that is not as soft as a traditional sandwich, because it does not contain the dangerous (and delicious) saturated fats (Hemme, 2019).

Even more surprising is the restaurant Gemüse, which has been influenced by Berlin's Gemüse Kebap and that opened in 2018, near the district of Montmartre. It is almost full all the time, and every month a new kebab is proposed there: e.g. Malian (with a mafé sauce, and served with sweet potato and gombo), Vietnamese (*banh mi* version), Indian (with mint sauce and cheese, mixed with curry and dahl – lentils). The star sandwich remains nevertheless the Berliner kebab: instead of a mixture of veal and turkey, Gemüse piles up on its skewers chicken meat, that has been "marinated for a long time in order to avoid the dryness of roasted poultry"; the proportion of the meat in the sandwich is generally *ca*. 160 g compared with 250 g elsewhere. The key ingredients are grilled vegetables: red cabbage, onions spiced with sumac, carrot, tomato, cucumber, salad, eggplant, zucchini, red bell-pepper. This is quite different from the common mixture of salad, onion and tomato. The overall result is a "traditional" sandwich that cost €7 (in 2019), plus homemade French fries, with parsley and spices, costing €3. This crispy and crunchy sandwich meets with the enthusiastic support of all nationalities (Hemme, 2019).

The restaurant Gemüse was founded by Noé Lazare, a 25-year-old graduate of law and political science (in 2019), who was so fond of kebab that he did not hesitate to travel for half an hour using public transport in order to taste a savoury sandwich. He decided to open his own business and to revive the kebab, relying on marinated chicken and above all on a lot of vegetables. He insisted on the fact that the kebab has been changing all the time. As recalled by Benjamin Baudis, the way of cooking meat on a skewer could be already traced to the nomadic and Persian tribes. "The vertical skewer was born around 1850 in Istanbul and during the 1960s the kebab became a fast-food sandwich in Germany, along with a massive arrival of Turkish migrants to this country," he explained. In France, it was the Greek community in the heart of Paris, in the Latin Quarter, who introduced the meal; henceforth the name of "greek" given to the kebab. That was another new change of the kebab. As French people spend more time at lunch or dinner, the sandwich is served with French fries, and a wider space was equipped with television sets. New sauces are offered to the customers: e.g. the *samourai*, a mixture of mayonnaise and ketchup with *harissa* (a Tunisian spicy paste made of ground hot pepper and olive oil), or the *sambal selek* (an Indonesian spicy paste), or the Algerian sauce, marketed around 2010, and made of mayonnaise, candied onions and spices. To sum up, "the kebab changes all the time in order to be in tune with the customers' tastes, i.e. from a country to another, or ever from a region to another one; for instance, in the eastern regions of France, the kebab matches very well with red or white cabbage," explained B. Baudis (Hemme, 2019).

According to a study carried out in December 2006 by the French Directorate-General for Competition, Consumption and Fraud Repression (DGCCRF, French acronym), the kebab did not seem to comply with the norms of hygiene valid in almost half of the fast-food restaurants. The study also pointed out its poor nutritional qualities: "It gets the premium award for junk food," stated the nutrition scientist Arnaud Cocaul. "A kebab's kilocalorie intake is twice that of a big hamburger," he added. Nevertheless, the kebab success story was not generally affected by those suspicions or statements: the annual sales in France have been estimated at 300 million units, and there were approximately 10,000 restaurants or shops selling this sandwich (Porier, 2016); most probably 350 million kebabs have been sold in France in 2017 (Hemme, 2019). The ratio quality/price was not the only explanation of this fast-food success. It seems that in the standardized world of fast foods, where each portion of bread and meat is exactly weighted, and where the general feeling is to make available "a food factory for people in a hurry", the kebab is more convivial and provides an opportunity to meet people and relax (Porier, 2016).

Why the kebab is called the "Greek" in France? "When since the 1970s Turkish people have migrated to France, Greeks had preceded them. We had to adapt to this situation," stated Hecati Celik, a Turkish man who has been running a Turkish-food restaurant in Paris for 25 years. "It was the same story as for our national alcoholic beverage, the *raki*; the French people already knew the *ouzo*, widely advertised by the Greeks," he added. As many of his fellow countrymen or women, this former professor of history and geography left Turkey by the early 1980s, when the country was under General Evren's dictatorship. *Ca*. more than 800,000 people of Turkish origin were living in France, compared with more than 5 million in Germany. Mehmet Aygun, a Turkish immigrant in Germany, who passed away in 2009 in Berlin, has probably conceived the modern version of this sandwich. A restaurant-owner from the Turkish town of Bursa, Cevat Iskender, had the idea to turn down the skewer on its base, to pile up the burning charcoal vertically around the skewer and the loaf of meat, so that the fat could slide down. This innovation was reborn in Istanbul around 1850 and it became the standard way of cooking the kebab during the 19th century. Since then, natural-gas heaters or electric wires have replaced the charcoal, and this has fostered the kebab spread across the world – it is more widespread than the *cuscus* or *couscous* (Porier, 2016).

J. Porier carried out the second part of his enquiry in the Montreuil area, centre-east of Paris. He discovered many kebab restaurants, bearing all of them a Turkish name, but often run by French citizens of North African origin. Although these restaurants served many kinds of fast food, such as fried chicken, hamburgers and pizza, they do focus on kebab, which they consider the best food. In that area, a young manager of one of these restaurants, having a master in international trade, wanted to improve the image of those who sell kebab, through the creation of a national trade-union of traditional kebab-fast-food restaurants. In another area, a little further north, near the metro station of Bagnolet, J. Porier asked the customers of a kebab restaurant why they had a preference for this fast-food. Their reply was: "We eat kebabs because it is a good sandwich and it is halal, which means that meat comes from an animal slaughtered following the religious Muslim rules; we always check the acronym AVS on the restaurant's shop window; one customer stated that the best kebab he ever eaten was in Ankara during his holidays" (Porier, 2016).

On the other hand, as do the Berliners, Parisians who live in the center of the city, are also following the fashion of eating a kebab: for instance, they flock to a fancy restaurant, Grillé, located in the second district of the city, where they can taste a high-trend kebab. Costing €12, i.e. twice the price of a basic "greek", it is a warm and soft spelt-made pancake, garnished with homemade French fries and veal from young calves. However, there are those who denounce this fashion of eating kebab on the social networks, but this probably means that the debate about eating this kind of fast food does not only occur among suburbanites, but also within the middle class of city-dwellers, or even within the upper middle class (Porier, 2016).

There are some good examples of improving the nutritional quality of the kebab. In the sixth district of Paris, in the Latin Quarter area at the restaurant called Delice Jussieu, the owner and chef is an Iranian Kurd who arrived in France in 2009, and he made the decision to replace the beef skewer (considered a little heavy) with a recipe inherited from his mother and consisting of a mixture of lamb, turkey, spices and bell-pepper. He also made his own bread, sauces and served fresh vegetables. On the other hand, Pierre Hemme, a French gastronomic journalist, considered that Özlem was a very good choice for those who like to taste an authentic kebab, of which all the components are homemade. This restaurant located in the 10th district of Paris (centresouth of the city) and opened only at lunchtime, was founded in 1987 by the father of the current owner, Edip Bolatoglu, trained at the French Ferrandi school. He stated that he was against the trend of "fast-fooding": "the industrially-made sauces destroy the real taste of the final meals; there is none of them here; he also gave away the French fries, because this was alien to his culinary culture." The dough is kneaded and cooked every day; and onto the skewer are slid thin slices of breast of veal, marinated in a mixture of spices and onion (kept secret), as well as turkey (less fatty and less expensive). The sauce consisting of tomatoes is also homemade; and to make it a little spicier, *harissa* could be added (the latter was considered very close to the Turkish spicy and hot sauce, prepared from red chillies that are dried on the households' roofs). Because French fries are banned, the chef is serving, as side meals, rice, wheat and vegetables. The overall result is a very cheap sandwich (€7 in 2019), considering the ingredients' quality and the amount of work devoted to the preparation of the kebab. In addition, Edip Bolatoglu does not care much about some of the current sophisticated variations of the sandwich (Hemme, 2019). In terms of calorie intake, a kebab garnished with French fries brings in an average of 1,340 kilocalories, compared with 1,463 kcal for a six-portion pizza (American dough), 1,020 kcal for fried chicken (Kentucky Fried Chicken type), with French fries, 850 kcal for a big hamburger (BIG MAC) with French fries, 480 kcal for a buttered sandwich with ham and salad, and 285 kcal for a Cesar salad (Porier, 2016).

A key ingredient of fast food: tomato sauce or ketchup

Nobody is totally sure where tomatoes originated, but the favoured answer is somewhere in South America, probably in a valley of Peru. They are then thought to have been transported up into southern Mexico through human and animal contact, and to have been eaten even before the Spanish conquistadores arrived. European first met with tomatoes soon after 1521 and although the stems and leaves of the plants were poisonous, they were soon being cultivated in Spain and Italy. In 1544, the

Italian physician and botanist Pietro Andreas Mattioli mentioned them in his *Discorsi*; that was the first mention in a published document. In England, not until the 1590s were tomatoes grown in the Holborn garden of London's College of Physicians. They did not feature much in cookbooks for another 100 years. They took off in French cuisine only in the middle of the 18th century. At that time, the English were calling them "love apples"; in Italian, *pomidoro* or "golden apples" (Fox, 2018).

Since then, tomatoes have proliferated. They became essential in cooking pasta and pizza. They have been transformed into a concentrated paste to be squeezed from tubes. They are the one fruit which is respectable for good cooks to use them from a can. They are part of the many meals of fast food. They have been condensed as a soup and added as a sauce to baked beans. They fathered the Bloody Mary drink (vodka and tomato sauce) in Paris in the 1920s, although its exact birthday has been much disputed. They are continuing to evolve through breeding and selection. In 2018, for instance, a new hybrid tomato in British catalogues was called Oh Happy Day! as it "offers late blight resistance and is delicious when sliced in a sandwich" (Fox, 2018).

In the United States, tomatoes concentrated at first on the east coast, with money to be made if early-cropping varieties could be transported fresh into New York. They spread to Florida, up to Ohio and across to California, their mostly renowned commercial home. John Hoenig (2017), a historian at Pennsylvania State University, described the transformation of tomato into a mass commercial crop. He explores the path by which, over the last two centuries, the tomato went from a rare seasonal crop to America's favorite vegetable. Where would American food, fast and slow, high and low, be without the tomato? The tomato represents the best and worst of American cuisine: though the plastic-looking corporate tomato is the hallmark of industrial agriculture, the tomato's history also encompasses farmers' markets and home gardens. J. Hoenig's book, *Garden Variety* (2017), illuminates American culinary culture from 1800 to the present, challenging a simple story of mass-produced homogeneity and demonstrating the persistence of diverse food cultures throughout modern America. In addition, he set out how Mexican workers poured north to pick America's tomato crops and were so crucial that Congress passed laws to permit them in 1951. In the 1950s the breeder, Jack Hanna, developed tomatoes on stems which could be mechanically picked. The canning of fruit and vegetables traces back to Nicolas Appert in 1810 who responded to Napoleon's offer of a prize for a discovery that would preserve fruit. He found that it would stay fresh in tightly-corked glass jars. The English inventor Peter Durand then substituted iron jars for glass ones (Fox, 2018).

What was the role of immigrant Italians in the tomato craze? Did they invent a new Italian style in the New World or were they introducing home-grown recipes? Thereafter, did mass marketing annihilate regional and seasonal diets? Tomatoes are prime exhibits in all this history. Unlike sweet corn, they were difficult to transport and the search for a "12-month tomato" was long and hard. One of J. Hoenig's main contentions is that tomatoes only became industrialized late on and even then, small farm production continued to dominate as consumers wanted a fresh tomato, not a canned one. Backward gardens and urban community plots proved to be quite productive and are now back on the increase (Hoenig, 2017; Fox, 2018).

At the same time, J. Hoenig gives fascinating sketches of the great business founders, Joseph Campbell, of what became The Campbell Soup Company, once canned a Beefsteak tomato, which filled an entire can. Henry J. Heinz began by selling bottled horseradish sauce from his grandmother's garden when he was only eight. J. Hoenig analyzed the crucial role of mass advertising in the Heinz rise to fame and the importance for both businesses of staking out a niche for highly processed, highly distinguishable goods in a well-populated field. Regarding ketchup, which caps the tale about tomato, J. Hoenig explains that ketchups go back to home-grown recipes and the 1810s. Nowadays, it has become a key ingredient in the preparation of all kinds of fast food or/and garnishing them with sauce before being sold. Nutritionists generally agree that tomato consumption is recommended, fresh, cooked or canned. But it is still advisable to avoid the too salty or sweetened items, such as ketchup (Hoenig, 2017; Fox, 2018).

Fast food and cooking areas in supermarkets

Supermarkets can become a space for preparing fast food or a little more sophisticated cooked meals. This approach consisting of devoting an area to this activity seems profitable and suits consumers' needs. For instance, since 2016, the French chain of supermarkets Auchan has been installing open kitchens amidst its department stores with a view to cooking meals. That has been a way to reallocate space formerly devoted to ready-made clothes or musics, which are now increasingly bought through the Internet. The objective of this initiative was to attract clients thanks to a bill of fare of meals, which have a better quality and are entirely prepared on the site (Prudhomme, 2018).

This trend is becoming a wide-ranging one; companies owning the supermarkets intend, by doing so, to broaden their usual activity through including the concept of a prepared meal. Consultants use the following phrase to designate this trend: "distriration", a contracted word for distribution and restauration. This trend mainly seems to attract urbanites. One should recall that one meal out of five is consumed out of home and that the market for "food service" in Europe was estimated at €4.1 billion in 2017. The increasing demand for practical solutions regarding meal consumption is associated with the transformation of families, in particular the high number of monoparental families or of persons living alone; they are also associated with the hectic rhythm of our lifestyle. Already in 2017, the offer of cooked meals and other food kits that are sold in supermarkets reached an annual turnover of €8.3 billion in Europe (Prudhomme, 2018).

According to Philippe Nobile, in charge of the distribution and digitalization at the Boston Consulting Group, the supermarkets have been inspired by the Italian concept Eataly, which puts cooking in the middle of the supermarkets, between the shops. Such concept has been considered very innovative some years ago and was very successful when it was first installed in the United States, in 2010. Besides the fact that the "millennials" (the new generation of consumers) are not so much interested in cooking, while they are at the same time very concerned about food quality, the supermarkets also want to highlight and advertise this new eating habit. Moreover, the economic profit has played a key role in the supermarkets' decision: the meals

prepared on the spot can yield a profit which is twice or thrice that derived from the other food shelves, if the supermarket is well located in order to have an important flow of consumers. It is also true that food preparation implies higher fixed costs – especially staff costs (Prudhomme, 2018).

The French supermarket chain Auchan has therefore opened cooking areas, with an individual surface of between 15 m^2 and 50 m^2. In 2018, this was the case of 15 out of 276 supermarkets and 142 hypermarkets, under the name of Auchan Retail France. By the end of 2018, the number of installed food areas was *ca*. 25. Therefore the company had to recruit professional cooks and also to train employees in food jobs. This initiative fits within the world strategy aimed at rethinking the role of the hypermarket, that has been unveiled during the spring of 2019. Auchan is experimenting this concept in other countries. For instance, in Bucarest, the capital of Rumania, it is possible to see the meals of the day from a distance, order them through the Internet and half an hour later come to the supermarket and pick them, or they can order them to be delivered at home or at the office. In Moscow, the customers can have their fish or meat, bought in the supermarket, to be cooked on the spot. In fact, this kind of food is not exactly fast food, because it involves the cooking of ingredients and the preparation of meals to suit the consumers' or customers' eating habits. It may be sometimes snack food or similar to street food, where simple meals are cooked and served from a truck having the main cooking tools or devices (Prudhomme, 2018).

In the case of Auchan, the person in charge of managing the project was Christophe Nerkowski, a former chef at the Hotel Cap-Eden-Roc in Antibes (south-east of France), who was also part of the team working in the cuisine of the Fer à Cheval (Horseshoe), Mégève, Switzerland. He has prepared a catalogue of 200 recipes, among which the chefs of the supermarkets can make their selection one week in advance and order the relevant ingredients from a number of selected suppliers. According to C. Nerkowski, "it is a novel profession; usually in the supermarkets items are purchased, then stored and finally sold. In this case, they are bought and transformed in order to be consumed almost immediately; if a meal does not fit the consumers' wishes, its ingredients can be used differently – e.g. chicken can be part of a Cesar salad or served in slices with mashed potatoes" (Prudhomme, 2018).

Near Paris, at the Auchan hypermarket located in the small town of Noyon (13,800 inhabitants), not very far (20-minute drive) from Compiègne, an area for food preparation and cooking has been created since August 2017, next to the fruit and vegetables section. This 6,200-square-meter hypermarket is attended by 3,000 to 5,000 clients a day; three chefs prepare 250 to 300 rations of 30 recipes to meet the daily customers' consumption. During the first five months of 2018, more than 10,400 food containers have been sold. This was a tiny part of the annual turnover of the hypermarket, the investment made in this activity being estimated at €80,000. At the same time, the sales of industrially prepared fast-food items slumped, because the customers were more attracted by the food prepared and cooked in front of them. The consumers, generally consisting of families and elderly people during the weekends, include during the working days employees of the newly nearby industrial zone, lunching among colleagues and seizing this opportunity to do some shopping; as well as high-school teenagers who also have their lunch there, using free transportation between the existing human settlements (Prudhomme, 2018).

This new approach to preparing food kits or rations attracts all brands, including those producing organic food, who see it as an extension of their main activity. For instance, the French Biocoop network has been negotiating with restaurant partners in order to find out those which could make an offer for prepared cooked meals. The subsidiary called Biocoop Restauration which supplies restaurants and school-dining halls thinks that this approach would facilitate the full traceability of what is produced and transformed to make food rations. Another brand, Franprix, also ventured in this area through its preparations of fast food. According to the deputy-director general of Franprix and since May 2018, the department stores Franprix Noé have been preparing small menus to be dispatched by Deliveroo; also they have built up a partnership with Just Eat and Glovo (Prudhomme, 2018).

Across the world, the trend is similar. For instance, Hema, the chain of supermarkets of the Chinese giant of e-commerce, Alibaba, has devoted about one-fifth of its markets to food areas and is cooking on the spot fresh produce bought by its customers in the supermarket. In the United States, this trend has been accelerated after the purchase in 2017 of Whole Food Market by Amazon. On the other hand, Albertsons, a West-American chain, has purchased the foodtech Plated in September 2017, while Kroger supermarkets have bought by the end of May 2018 Home Chef, the third-biggest American company specialized in cooked meals, for US$200 million or €171 million. Finally in 2018, Walmart – the historic American behemoth department store – has started to commercialize its own cooked meals – sold on line or in its proper stores – and the forecast was to sell them in *ca*. 2,000 supermarkets by the end of 2018 (Prudhomme, 2018).

Innovation in fast food in France

In this country and over recent years, the fast-food offer has been diversified and has become more sophisticated – and sometimes not that cheap, e.g. a meal would cost between €28 and €30. Even some renowned chefs have been attracted by the trend and brought innovation into the variety and quality of meals offered. According to Gira Conseil, a consulting firm, the number of different formulae or offers provided to the French customers was at least *ca*. 38 in 2017. For instance, the burger – by McDonald's and Burger King, for instance – has become more sophisticated and sold by such French chains as Big Fernand, Mamie Burger or Factory & Co., as well as by American competitors like Five Guys. The brand Cojean was considered a pioneer in this ebullient market, offering on its bill of fare healthy and carefully prepared products. In other words, it tries to break down the traditional way of associating fast food with junk food. Many other investors or managers have followed suit and everyone had its own recipe. In a country well known for its buttered sandwich with ham (*jambon-beurre*), there are now a lot of ways to trim bread. For instance, the bakery chain Kayser has opened spots for fast food; or the company called Les Bols de Jean, which offers to its customers meals within hollowed bread looking like bowls; or Tartin'Art, a brand promoted by a cereal-ingredients company, Eurogerm, and serving salty and buttered slices of bread (Girard, 2017b).

Other fast-food brands or companies highlight a special product in their meals, such as lobster, but more simply eggs or chicken; Arsène sells all kinds of omelettes, while the brand Poulet Poulette served meals based on chicken – far away from the American giant KFC or its competitor Popeyes Louisiana Kitchen, a newcomer on the French fast-food market. Fast food also tries to bring in food traditions from foreign countries. In addition to all kinds of pizza – originally from Naples – Greek specialities are sold under the brand Gallika, while Pitaya promotes Thai food. O'Tacos, which had in 2017 *ca*. 90 restaurants in France, has been trying to sell new versions of the Mexican *taco* – a kind of maize flat bread filled with meat or a mixture of meat and vegetables (Girard, 2017b).

Moreover, some companies have devoted part of their business to fast-food spaces with a view to promoting their brands. For instance, a small-sized fish-canning company, called La Belle-Iloise, opened a restaurant, La Tablée, in the city of Nantes (centrewest of France), serving menus based on the canned fish produced by the company. Likewise, another company called Senoble, opened in Paris in 2017, a tasting place where it is selling its own food specialities. Even the big dairy group Danone had also a space called *Les 2 Vaches* (The Two Cows), where its organic products can be tasted (Girard, 2017b).

Finally, the döner kebab, a sandwich filled with meat roasted on a skewer, generally garnished with French fries, and a mixture of salad, tomato and onions, imported from Turkey and Germany, has become more fashionable than the burgers, and ahead of *tacos*, *sushis* and *dim sums*. Even though there is not so much advertisement or marketing about it, the kebab often called the "greek", has become the preferred sandwich of a generation of French people belonging to all social categories and origins (see below).

Fast food and good food in a lovely environment

An example of fashionable "good-food" served in a fast-food restaurant exists in the French city of Bordeaux (centrewest of France): at Massa, at lunch time, people queue up to buy food wrapped in brown bags. In this kind of modern and convenient canteen, the menu seems a little complicated, with strange names for the food: for instance, *babaganoush*, *haminados*, *foul mdammes*, which mean smashed eggplant, marinated hard boiled eggs and stew of dried faba beans. This fast-food restaurant is a joint venture between a French man of Vietnamese origin, a Japanese woman and an Israeli – three inventive cooks who have travelled a lot and who own two renowned and crowded restaurants in Bordeaux. Massa's clients include mothers with their impatient children, graduated students, young retired women; they may select for their lunch a Cairo-inspired *falafel* sandwich (which is garnished with *babaganoush*, *foul mdammes*, *haminados*, pickle and tomatoes) or a *freekeh* salad (made of grilled green wheat and salad of the season, tomatoes, peppers, *haminados* and preserved lemon), and a dessert consisting of an ice cream of *tahina* (sesame cream). A beverage that includes the flavours of mint and hibiscus – a sour and refreshing beverage – is part of the menu, which cost *ca*. €13. This was considered a reasonable cost for a concentrate

of savoury Mediterranean food, eaten quickly and made of healthy ingredients – the Mediterranean diet has been recognized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as part of the List of the World's Non-Physical Cultural Heritage (Aline, 2018a).

On 29 March 2018 was inaugurated the first "fast-good (food)" in France, on the Champs-Elysées Avenue – the so-called most beautiful avenue in the world – in Paris. This was the first fast-food restaurant in the French capital which combined good and healthy food within a space beautifully-designed. The restaurant is called The Marxito – a contraction of the name of the French chef, Thierry Marx, and that of the Japanese designer Ora-ïto. Not only Ora-ïto has designed the interior of the restaurant, but he became a partner of the renowned cook in this joint venture. Ora-ïto had already designed a hotel in Paris with the artist/architect Daniel Buren, as well as a tramway in Nice (southeast of France) and a contemporary-art center, called MaMo, in Marseille (southeast of France). Making a comment at the opening of The Marxito, Ora-ïto said "I very much like to eat fast and healthy. In Paris there is a lack of nice spots where we can have a choice of gourmet sandwiches, made of good ingredients supplied by local producers." In the same wane, the main cook of the Mandarin Oriental hotel in Paris, added: "Why should a fast-food restaurant be ugly? There is no conflict between what is beautiful and what is useful." In the Marxito, Thierry Marx sells five kinds of salted or sweet buckwheat-pancakes – inspired from the Japanese *dorayakis* of which 80% of the ingredients are of plant origin. For €5-€10, one could lunch and get value for money. Thierry Marx is of the opinion that street food is "a powerful way of integration within society." Indeed, the members of the team working at the Marxito were recruited among the graduates of Thierry Marx's school, "Cuisine Mode d'emploi(s)", whose main objective is to foster employment and societal reinsertion of youth (Lorelle, 2018).

The big commercial interests behind the fast-food industry

According to the data provided by the strategy-consulting firm OC&C, mergers and acquisitions in the consumers' goods sector had reached record figures in 2017, a total of 60 operations amounting to US$145 billion or €127 billion. For instance, Danone purchased the American company WhiteWave, specialized in organic dairy products and plant proteins, with the brand Alpro in Europe, for more than US$11 billion – that operation probably meant a reaction to the decrease in yogurt sales in Europe. Nestlé sold its American confectionery subsidiary and partnered with Starbucks, while also purchasing Freshly, a startup delivering cooked meals, or Sweet Earth, specialized in vegan foods. By the end of June 2018, the American company Conagra purchased Pinnacle Foods in order to create a giant corporation specialized in frozen foods, for US$8.1 billion. By August 2018, there were also rumours about a possible purchase of Campbell Soup by Kraft Heinz. The roadmap does not seem to be easy for agrifood multinationals to maintain their size and turnover, and also to adapt their products to the consumers' evolving tastes, especially with regard to the fast-food industry. That was probably the reason why many of them changed their chief executive officers (CEOs) and higher managerial staff (Girard, 2017b). See p. 71.

McDonald's dominance

In August 2018, China's largest private equity deal was predicted to occur: an investor group including Hillhouse Capital Management and KKR was hungry enough to bid almost US$18 billion fro the China operations of Yum Brands, the company that controls KFC (Kentucky Fried Chicken) and Pizza Hut. On Tuesday 28 August 2018, Yum China, which was spun off from its United States parent in 2016 and trades separately on the New York Stock Exchange, rejected the offer – only for its shares to rise. Investors expected nevertheless a deal to happen. If they were right, it would fuel the fast-food fight between Yum China and its biggest local competitor: McDonald's. The chains are trying to find the formula for success across a country where neither existed until about 30 years ago. The Chinese golden arches had just celebrated their anniversary under the majority ownership of investment firm Citic Capital, Citic group and Carlyle. The three paid just over US$2 billion for their combined 80% stake in the mainland and Hong Kong operations of McDonald's. Many customers come to McDonald's for the three flavours of *congee* for breakfast, the meal when consumers are least likely to experiment. They also drink mango bubble tea after finishing their burgers (Sender, 2018).

Since Yum China was spun off from its parent, it has done much of the heavy lifting. KFC has expanded across the mainland and in 2018 had 6,000 stores. It has reduced costs at a time when it is difficult to raise prices. Meanwhile, McDonald's lagged behind its rival when Citic and Carlyle bought in. McDonald's US retained a 20% minority stake in the Chinese and Hong Kong operations. In 2015, McDonald's was caught up in one of the China's many food scandals – as was Yum a few years earlier – after it was found to be using contaminated chicken and beef. Its profit margins were under pressure. Sales are weak as consumers cut back. But McDonald's is expanding and investing, underscoring the advantage of being owned locally and no longer having to fight for resources. McDonald's China and McDonald's Hong Kong have expansion plans to close the gap with Yum China, which has twice as many outlets in China. Executives are envisaging the restaurant of the future, which means everything from store design to using tablets to place orders, to making food healthier – by offering customers the choice between grilled or deep fried – and eliminating the use of plastic containers. Moreover, McDonald's China can extract other benefits from Citic as it seeks to close in on Yum China. For instance, because Citic's property arm has relations with all the biggest developers, it can work with developers to lock up prime space for restaurants, even while a big housing estate or shopping mall is still no more than a blueprint. Citic has always been close to Tencent – the Chinese telecom company – and has used Tencent's WeChat extensively to help compensate for the weakness of the McDonald's app. Before the sale, the United States parent did not have much time for China, which accounted for a mere 5% of sales, in contrast to Yum, where the comparable figure was *ca*. 40%, stated the head of Citic Capital (Sender, 2018).

More focused business strategies

As mentioned earlier, mergers and acquisitions in the fast-food industry, but also consumers' goods businesses, aimed at winning more parts of the markets and consolidating the groups' expansion. Also for a company to shed out a series of

activities is another way to focus on its core business. For instance, the new chief executive officer (CEO) of Nestlé, Ulf Mark Schneider, decided on 20 September 2018 that Nestlé Skin Health company was no more useful for the group's strategy that must be focused on "food products, beverages and nutritional health." Nestlé Skin Health, specialized in skin-health care, was created in 2016, further to a redistribution of equity within the big cosmetic group L'Oréal – the world's leader. The heirs of L'Oréal had decided then to increase their participation up to 33.31%, while that of Nestlé was reduced to 23.29%. The dermatologic laboratory Galderma had served as the money exchange: Nestlé could recuperate 50% of the capital detained by L'Oréal, and this was the basis of the creation of Skin Health subsidiary. Nestlé had invested *ca*. €1 billion in the company to strengthen its role in the skin-health care. In September 2018, Skin Health was valued at €2.3 billion and was employing 5,000 persons across the world (Girard, 2015a).

Since the appointment of Nestlé CEO, in January 2017, operations similar to Skin Health's sale have been listed, such as the sale of the American confectionery subsidiary to the Italian Ferrero for €2.4 billion. On 18 September 2018, Ulf Mark Schneider announced the sale of its life-insurance subsidiary, Gerber Life Insurance, to the American group Western and Southern Financial Group, for US$1.55 billion or €1.3 billion. By contrast, Nestlé made a number of acquisitions which consolidated its core business. As mentioned earlier, Nestlé was able to buy out Sweet Earth, specialized in organic products; Freshly, a company that delivers cooked meals; as well as Atrium Innovations, a Canadian food-additives company. Nestlé also strengthened its position in the strategic market of coffee through the buying out of the American chains Blue Bottle Coffee and Chameleon Cold Brew; but, above all, it built up a €7 billion partnership with Starbucks with a view to selling this brand in supermarkets across the world. The strategy of Nestlé and its new CEO was to increase its growth rate from 2.4% in 2017 – the lowest growth rate in 20 years – to around 5% in 2020 (Girard, 2018f).

Taking now the example of Walmart – the world's biggest distributor of consumers' goods – we can see the constraints linked to its global development, such as the heaviness of management, the human and material cost of expansion beyond borders, and the rough competition coming from everywhere. Walmart, by announcing its withdrawal from Great Britain and Brazil, goes once again through that painful experience. Born in the State of Arkansas in 1962, the small grocery of Sam Walton has become, in forty years, the world's first enterprise. In 2018, it employed 2.3 million persons across the world and its annual turnover in 2017 amounted to US$500 billion or €412 billion. By the end of the 20th century, Walmart's objective was to flood the global market with its jeans, television sets and tomato cans, at very low prices. Being itself a "product" of globalization, it has largely contributed to China's development due to its massive orders of textiles and electronics in order to refill its stores. In 1995, it started its operations in Brazil and in 1999, it launched its activities in Europe through the acquisition of the third-biggest British distributor, Asda (Escande, 2018).

But the expectations and results were not those imagined at Walmart's headquarters in Bentonville, Arkansas. For instance, the Brazilians prefer the cash-and-carry approach, which means wholesale deals in the stores, while the European consumers prefer to buy small quantities of goods in smaller stores. Consequently, the expected tsunami in sales and results did not occur. Sainsbury's, the second-biggest distributor in the United Kingdom, which was supposed to be swallowed by Walmart, was to purchase Asda in a deal including the participation of Walmart in its capital. Moreover, Walmart, with a very disciplined organization, has experienced difficulties to withstand the competition of its Indian and Chinese rivals. The dilemma of Walmart is the same as that faced by all commercial empires. To be sure to win the heart of the consumers of a conquered country, should one take the risk to lose its identity and organization which make up its strength? And particularly when younger and clever rivals seize any opportunity to encroach on the markets supposed to be conquered. In Europe, the rivals are the German city-discounters such as Aldi and Lidl. In a few years, these have been able to capture 12% of the British distribution market. In the United States, another big player is Amazon, which is increasingly nibbling market shares; to the point that Walmart had to make more and more advertisements and to diversify its investments – for instance with the Chinese JD.com, with the Japanese Rakuten and the Indian specialist of online sales, Flipkart. It seems that Walmart has reached its limits and will not be able to rule the world. Two-thirds of its annual turnover are made in the United States, and this may not change soon. Regarding business and trade, it does not seem that the trend towards dominance can forestall forever the world complexity (Escande, 2018).

Rebranding

Dunkin' Donuts is removing "donuts" from its name starting in 2019, making it the latest in a string of companies aiming to breathe fresh life into their brands with a name change. Dunkin' Donuts got its name in 1950, when its founder renamed its original shop, which was known as Open Kettle. As of 2017 the United States had over 9,000 Dunkin' Donuts locations. The company tested the new name over the year 2017 and the response has been "overwhelmingly positive," stated Tony Weisman, chief marketing officer of the company in the United States. The shift is a nod to the chain's beverage sales, which account for *ca*. 60% of its business, and the popularity of its long-time slogan, "American Runs on Dunkin." David Hoffman, chief executive of Dunkin' Brands, emphasized that this shift was precisely about the chain's broader growth strategy to sell beverages – primarily coffee – to people on the go (Maheshwari, 2018).

Dunkin' – as it is known for now – is one of many companies to declare a new name as part of a broader rebranding strategy. Also by the end of September 2018, Weight Watchers announced that it was now WW – an attempt to emphasize a focus on wellness instead of weight loss, with the tagline, "Wellness that works." The restaurant chain IHOP even used a name change as a marketing gimmick during the summer of 2018, when it temporarily changed its name to IHO-b, for "International House of Burgers" (Maheshwari, 2018).

Mumbai: the star of Indian street food

In Mumbai, street food has become a real lifestyle. Thus, at the southern point of this big industrial city and harbour (northwest of India, capital of the Maharashtra State), street-food cooks arrive at dawn and set up their small kitchens at the corner of Dalal Street, near the Stock Exchange Tower. In Delhi and Kolkota (Calcutta), people eat in the streets, but in Bombay this behaviour has become a real lifestyle. Customers are busy businessmen as well as lawyers who work at the nearby Palace of Justice, and staff people who are still hungry after having swallowed a light meal at home in the early morning. On the ephemeral stalls, the "burger of Mumbai" or *vada pao* is the preferred street-food item. It combines the crispiness of a fried ball made of mashed potato mixed with chickpeas and hot chilis (*vada*), with the irresistible rubber-like texture of the *pao* – the square bread which surrounds it – a reminder of the *pão* that was introduced by the Portuguese Jesuits which settled in Mumbai in the 16th century. According to Aakar Patel, a journalist, who joined Amnesty International India, street food in Mumbai has its origin in the Secession War, which wreaked havoc upon the United States at the end of the 19th century. For that reason, Indian cotton ranked far ahead of American cotton on the global market. The Kala Ghoda district, where cotton prices used to be negotiated, attracted thousands of merchants from the neighbouring State of Gujarat, well known for the entrepreneurship of its inhabitants. These new migrants used to work for long hours and late at night; hence the proliferation of stalls offering light vegetarian meals (Delacroix, 2019).

A century ago, all along Dalal Street – Mumbai's equivalent of Wall Street in New York City – cooks would stew vegetables left over at the end of the day, then, crush them together with copious amounts of butter. They served this rich, savoury mash, called *bhaji*, to the traders going home from the Stock Exchange, most of whom were vegetarians from the State of Gujarat to the northwest. Nowadays, in the evening, stalls still keep a mash of potatoes, peas, tomatoes, onions and green pepper simmering away on the *tava*, a large disc-shaped metal griddle, prepped with plenty of butter – the Amal brand is favoured for its deep yellow colour and full-bodied flavour. For every order of *bhaji*, two sliced, buttered *paos* – puffy white rolls – are heated on the *tava* as well. They are perfect for scooping up the spicy, red-hued mix served on a stainless steel plate with a pile of chopped red onions and a slice of lime. The whole *pao bhaji* can be washed down with a glass of fresh-squeezed *mosumbi* (sweet lime) juice.

Nowadays, in the Kala Ghoda district, the 21st century tourist can still see crowds which are present at any time in this district that is changing quickly; e.g. the old synagogue Knesset Eliyahou has been refurbished and it is surrounded by art galleries and trendy shops. When one is heading for the neogothic railway station – called Victoria Terminus for a long time because it was dedicated to Queen Victoria, empress of the British Empire – a stopover should be made at the Cannon street-food stall; here crowds of young people heartily eat the *pao bhaji* (Delacroix, 2019).

In a book published in 2010, Vikram Doctor (2010), a prominent food critic writing for the Indian financial newspaper, *The Economic Times*, made the following warning: "Tourists generally avoid using ice cubes and they brush their teeth with mineral water,

but they will not know India without tasting its street food, whatever might be the consequences for their guts." But there are good news: in the southern area of the city, there are many restaurants with impeccable hygienic conditions, serving Indian famous meals. For instance, Mumbai's Lower Parel area has The Bombay Canteen, a casual dining space for its chef's avid foodies. The restaurant is located at Kamala Hills, near Radio Mirchi office, and is a favoured dining spot for all-age groups. The beauty of the Bombay Canteen lies in its simplicity. It is designed like an old Bombay home with a veranda and a central dining area, which is basically designed with patterned floors and glass-panelled windows. On the left side of the room is an open bar that holds an impressive collection of alcoholic beverages. The overall idea is to keep the interiors subtle, not like neighbouring establishments which prefer to make themselves more eye-catching. The restaurant, opened in 2015, is attended by well-off young people and it serves homely *desi* food with a unique twist.

Its chef, Thomas Zacharias, is fond of making the street food "funny and exciting." His *pao bhaji* is served already garnished, after being drawn from the oven in order to increase its savour. In the case of *sev puri*, a crispy pancake buttered with chutney and powdered with crumbs of dried noodles, T. Zacharias has substituted the traditional wheat flour with a tuber called *arbi*, which he grinds, fries and mixes in a vegetable mill. The same T. Zacharias met once on the pavements a man who was toasting green chickpeas, that were thereafter sprinkled with lemon juice before being sold in newspaper cornets. This gave him the idea to prepare a salad made of the same kind of chickpeas, physalis (ground cherries) and *tendli* – an Indian substitute of gherkin –, which he serves on the top of an avocado-colour *hummus*. That was simple and refined (Delacroix, 2019).

In 2019, near Chowpatty Beach, Pinky Chandan Dixit has been cooking for almost 15 years at Soam, a restaurant located at the bottom of the stairs climbing to Babulnath Mandir, a splendid Hindu temple devoted to Shiva since the 12th century. Born in Gujarat, this young woman highlights the delicate combination of sweet-salted and spiced savours of the *ragda pattice*, a pâté made of grilled potato, and covered with a yellow-lentil purée, seasoned with fresh coriander and topped with a slice of mango. "This kind of meal helps the pilgrims visiting the Shiva temple to withstand the unbearable tropical heat and to remain hydrated, while not having a heavy stomach," explained the chef. It is also recommended to eat the *sabudana khichdi*, which are sago-palm sap pearls that cook like cassava, mixed with peanuts and served with a slightly sweet yogurt flavoured with cucumber and mint. This snack is highly appreciated by the Hindus during fasting periods, "because it kills the appetite and has a nutritional value almost nil." Finally, after a strolling on Malabar Hill, that is not very far from Chowpatty Beach, one could taste the *pani puri*: small fried balls which are delicately punctured with a small fork in order to introduce a mixture of lentils, coriander broth and a sweet-sour sauce; they are thereafter swallowed at once. For those who want to try street-food in a luxury hotel, they can taste *pani puri* at the Sea Lounge restaurant, at the Taj Mahal Palace – the most famous hotel in Mumbai; they can do so while overviewing the Indian Gate, the symbol of India's independence (Delacroix, 2019).

Street food in Taiwan

Sometimes, the Taiwanese people mention that their island has the shape of a sweet potato, long and rounded. Like those which are cooked in an oven or steamed, sold by street peddlers along the 900-stair pathway leading to Mount Elephant – a hill that overlooks Taipei, the capital of Taiwan. Although the cultural heritage existing in Taipei or in the historical city of Tainan does not have the renowned prestige of those of Shanghai or of the Forbidden City in Beijing, Taiwanese streets and their markets have a vibrating life and their street food is mouth-watering; e.g. around the remnants of the Zeelandia Fort in Tainan, built by the Dutch settlers in the 17th century. Nowadays, Taiwan has become a fashionable spot for the "foodies" across the world. The richness of Taiwanese cuisine reflects its maritime environment: fishes and seafood, supplied by some 200 fishing harbours, associated with vegetables and rice, are the basis of the diet of most island dwellers (Davet, 2019a).

But an aborigen community still lives on the island and has maintained its specific cuisine. These people fled from their Chinese province of northern China and migrated towards the south of the continent; the Hakka crossed the straight of Taiwan during the 17th and 18th centuries and they were numerous to settle in the premountainous regions of the island. They developed a cuisine that can be tasted in many restaurants of Taipei, such as the Tung Hakka cuisine, on Minsheng East Road, in the district of Zhongshan. Among many meals, often rich and flavoured, one can quote the sauteed pork with dried squid, garnished with cubes of *tofu* (soybean paste) and onions, or the famous chicken cooked for a long time in a mixture containing equal parts of soybean sauce, sesame oil and sugar (or rice wine), which gives to the poultry portions a mellow caramelization (Davet, 2019a).

Japanese colonization during half a century has left an obvious imprint in the mindset of people as well as in their eating habits, such as the intake of algae, raw fish, octopus balls, tempura or deep-fried foodstuffs. The impact was even greater with the migration in 1949 of 2 million Chinese people from Mainland China, who were the followers of Tchang Kai-chek and Kuomintang, defeated by Mao Zedong and the Chinese Communist Party. Taiwan could benefit from the culinary cultures and knowhow of all the provinces of the Celestial Empire. One of the renowned chains of restaurants of the country, Din Tai Fung, reflects this multiple heritage. The first restaurant of this chain was created at the beginning of the 1970s by a Chinese chef from the Shanxi province, who migrated to Taipei in 1948; he hired cooks from Shanghai in order to put on his menu their special meal called *xianlongbao*, or soup dumplings – a king of ravioli filled with a jelly-rich stuffing that becomes in the mouth a boiling hot broth, because of the steam-cooking. In order to taste these *xianlongbao* with pork, shrimps, crab eggs or even with truffles, the pasta should be first pierced with a view to "soak the soup," before swallowing the rest – a mixture of soybean sauce, rice vinegar and ginger (Davet, 2019a).

While beef was little consumed in the island, it has become the basis of one of the Taiwanese specialties, the beef noodle soup. The latter was originally imported from the Chinese province of Sichuan; it looks like a pot-au-feu (boiled beef with vegetables) to which is added wheat pasta. There are many competitions around this meal among

the restaurants of Taipei. Its culinary secret is a condiment made of spicy beef fat. But it is above all along the streets that Taiwanese cuisine is thriving. Along Dihua Street, for instance, there are many shops selling dried products: fruits, plants, algae, mushrooms, shrimps, scallops, jellyfish, squids with an iodine-cured scent, but also the very costly bird's nests, shark's fins, mullet roe in its wax coating (equivalent to the French salted and pressed mullet roe), sold like pieces of jewellery. In addition, as it is usaual in China, food is sold next to the pharmacopeia (Davet, 2019a).

It is also true of the numerous markets of fresh produce, where the farmers are still resisting modernity. For instance, at the corner of Shennong Street and Hai-an Road, in the West Central district, in Tainan, there are many stalls packed with subtropical fruits and vegetables sold by women wearing traditional headdresses. In addition, there is a wide offer of pork and poultry, either raw, Peking-duck style, fried or poached in a soybean sauce. Moreover, there is in this harbour city an impressive variety of freshly-fished shell-molluscs, crustaceans and fish. The milkfish, a long freshwater fish, is highly appreciated, but its flesh filled with bones needs skillful experience in order to transform it into fillets; the milkfish's soft belly is considered as its most tasteful part. At one of the most refined restaurants of Tainan, Zhu Xin Ju – a century-old firm of high reputation –, the milkfish is garnished with *tofu*, fresh pineapple, chilli and spring onion, and topped with slices of young raw ginger (Davet, 2019a).

Taiwanese people prefer snacks to long menus; they grab the so-called *xiaochi*, especially at the night markets which make the island one of the world's most coveted places of street food. Culinary stalls are everywhere, e.g. at the Wusheng Night Market of Tainan, or in Taipei, along Ningxia Road, in the Datong district, or along the 600 m of Raoha Street which leads to the gilded temple of Ciyou. Many of these small shops are packed with seafood enjoyed by local or tourist customers – shrimps, fish and squids are grilled on smoulders or cooked in woks. Oysters, sweeter and less iodized than those of the West European coasts, are cooked and served in an omelette, garnished with salad and soybean sprouts. This is a very popular meal among street-food gourmets: frying large omelettes of this kind in large pans and then cut into big portions. Among the other preferred snacks of these night customers, one may quote: the *gua-bao*, which is given the nickname "the tiger that bites the pig" and refers to a steamed brioche-like bread, stuffed with pieces of braised belly pork, vinegar-soaked cabbage and slightly sweetened peanut flour; fried marinated chicken; a variety of kebabs, selected by the customer before being grilled; raviolis filled with sticky rice. Some of these street-food shops are renowned because of their innovations, such as that which serves fried big squids stuffed with cucumber or that which sells amazing doughnuts made with mashed *taro* (a slightly pink and sweet tuber), and stuffed with a salted duck egg and dried silky pork (Davet, 2019a).

Some snacks could nevertheless be far from being tasteful for Western palates, e.g. the *stinky tofu*. This is a deeply fermented *tofu* which the locals enjoy in various forms: fried, steamed, with chilli sauce, or in a soup containing duck blood, pork tripe and mushrooms. There are several beverages available like papaya milk, bubble tea – tea with milk and tiny beads of cassava –, as well as many desserts such as those made of herbs or fruit jelly, garnished with grated ice cream, coconut milk or sour prune syrup (Davet, 2019a).

SLOW FOOD, ORGANIC FOOD

A drastic change in consumers' eating habits

As opposed to fast food, Slow Food is an international movement, fostered by Carlo Petrini in 1986. The movement is strongly advocating the consumption of "good, clean and equitable food," meaning in particular a fair reward or price to small producers, organic farming and short circuits between producers and consumers. Such a way of thinking and consuming has been pervasive into the whole world of food behaviour, to the extent that some marketing agencies have changed their business toward selling studies on the trend of "slow-fooding." This international movement reflects the increasing concerns of consumers about the health quality of food intake: both when the consumer fills its shopping bag and when he/she prepares the meals. It has become obvious that the healthier quality of food jumped at the top of consumers' concerns over recent decades.

The numerous scandals about contaminated food have induced the mistrust of consumers versus industrialized foodstuffs: the fraud about replacing beef by horse meat in lasagnas (in France); the contamination of eggs with fipronil, a pesticide used in chicken breeding (in France and part of Europe); Lactalis' milks contaminated by salmonellas and consumed by infants and young children; Chinese milks contaminated with melamine, etc. All these scandals which are denounced by such non-governmental organizations as FoodWatch, quite often, underline the increasing difficulties of a self-control policy of food companies and the subsequent frequent withdrawal of the contaminated foodstuffs from the shelves of supermarkets and shops. At the same time, enquiries made by the television networks on the hidden facets of the food industry, as well as the medical studies highlighting the relationship between food intake and several pathologies – diabetes, obesity, cancer – have strongly contributed to consumers' distrust.

The signs of this distrust have been shown in a study carried out by the French polling company, IPSOS, from 20 February 2017 to 3 March 2017, among 2,000 French women and men, aged between 18 and 70 years: 70% of the people interviewed were of the opinion that the quality of foodstuffs has been deteriorating in recent years and less than 30% thought that it was recommended to buy a renowned brand of foodstuff (and expensive) in order to be on the safe side regarding the healthy properties or quality of that foodstuff. The same study also showed that French consumers are becoming more demanding: 49% of those interviewed buy organic food produced by biological or ecological agriculture, particularly vegetables and fruit (33%) and eggs

(26%). They also prefer to buy French products (52%); this is particularly true of meat (38%), eggs (38%), vegetables and fruit (37%), as well as bakery and pastry products. See pp. 117-118.

A study by the French company Xerfi, published in July 2018, revealed that at least 30% of French consumers were reducing their meat consumption, while plant-based protein sales skyrocketed by 82% in 2016, with a total value to €30 million. And according to the data, the number of consumers adopting more vegan-buying behaviours was set to rise by 25% annually until 2020. Sales of vegetable protein are surging as well, becoming "an unavoidable substitute," according to *Bloomberg*, with sales expected to grow 25% by 2020. In France, in 2018, the retail and supermarket chains had a total turnover of 380 million in the vegetarian and vegan market. Although there are cultural obstacles to veganism in France, flexitarianism is becoming increasingly popular. According to Xerfi, vegetarians and vegan together make up only 2% of the French population, whereas flexitarians make up about a third of the population, almost 23 million people. Large retailers and food producers are increasingly focusing on vegetarian and vegan products and are constantly expanding their share in this area. According to the Xerfi study, for the period 2019-2021, annual growth rates of 17% were forecast for the vegetarian and vegan market in France, corresponding to a market valued at over €600 million by the end of 2021. Xerfi also pointed out that the increase in the consumption of plant products is a "big trend" (*Vegconomist*, 2019).

It has been forecast that the world's market of plant proteins will have an average annual growth rate of 5.5% and would reach the threshold of €11 billion in 2020. The Xerfi study and many others show that these new food behaviours are part of a deep and wide trend of consumption, especially among the so-called "millenials" – aged between 18 and 35 years – with a middle or high income. This trend lays more emphasis on a thoughtful and responsible consumption. It is "thought for good", which means above all to consume less meat, to buy good-quality foodstuffs produced, if possible, in the vicinity by organic farmers, livestock breeding or craftsmen. This more responsible consumption is part of a general commitment to protect the environment, to save energy and to support a more sustainable agriculture; consumers' concerns are not only focused on the ways the products they buy are transformed or processed, but also on their packaging, e.g. biodegradable containers, boxes and bags.

Such new trends of consumption could hamper, at least for sometime, the purchase of some products, like cooked meats – where the presence of nitrites was demonstrated in several items or brands –, or salmon – when conditions of intensive salmon farming in Norway were scrutinized with respect of their sustainability and possible environmental degradation. Generally the products are withdrawn from the market and, thereafter, companies try to restore consumers' confidence regarding the healthier or environment-friendly characteristics of their brands or products. To support this new trend of consumption, it is increasingly advisable to buy and eat locally, and consume foodstuffs at the right season – fresh produce at the right time of maturation and taste. This advice of buying foodstuffs through short circuits, from the producer to the consumer, contributes to help small producers, when multinational corporations' products have a higher carbon footprint and sometimes a poorer nutritional quality

or value. For instance, French associations supporting small-scale agriculture (AMAP, French acronym) and other types of shortcut circuits aim at preventing the damage caused by an agroindustry caring less about product quality and the environment. This movement has been christened "locavorism", i.e. eating homegrown good-quality food.

Challenges of organic farming

Realities and prospects

According to the Food and Agriculture Organization of the United Nations (FAO), agricultural production should increase by 50% in 2050 in order to feed the more than 9 billion people living on the planet Earth. This extraordinary effort will have an impact on the natural environment and climate change. Thus the question is: how to produce such quantity of food, but in a different way? FAO-funded researchers, helped by the data supplied by the United Nations agency, have built models regarding the agricultural acreage that would be necessary to withdraw the same amount of calories (2,700 kcal per person and per day) in 2050, with different proportions of organic farming (0%, 20%, 40%, 60%, 80% or 100%), and bearing in mind several levels of impact of climate change on yields. The first result of this work was that the conversion of the whole world agriculture to organic farming would need to cultivate 16% to 33% more land in 2050, compared with the average of land cultivated between 2005 and 2009. Such surplus of land brought into cultivation can be compared with only +6% in the FAO reference scenario, based mainly on conventional agriculture. But yields in organic farming are lower than in conventional agriculture, and such hypothetical transformation of agriculture would cause more deforestation across the world (+8% to +15%) – with dramatic implications for climate change (Garric, 2017). On the other hand, the change (100%) toward organic farming across the whole world would seriously decrease the pollution due to the inputs of pesticides and chemical fertilizers, as well as the use of fossil energy. The emissions of greenhouse-effect gases of organic farming would be 3% to 7% lower than those expected in the reference scenario – this was considered "a small gain" by the researchers.

Another study, published on 14 November 2017 and carried out by Muller, Schader et al. (2017) belonging to the Research Institute of Organic Agriculture (Switzerland), the Institute of Environmental Decisions, Department of Environmental Systems Science (Zurich, Switzerland), the Institute of Social Ecology (Vienna), University of Aberdeen, Aberdeen, United Kingdom, and FAO, has used a food systems model that addresses the characteristics of organic agriculture to analyze the role that this kind of agriculture could play in sustainable food systems. As mentioned above, organic systems produce lower yields and thus require larger acreages to deliver the same output as conventional production systems. Consequently, the environmental benefits of organic agriculture are less pronounced or even absent if measured per unit of product than per unit of area. Furthermore, abandoning synthetic nitrogen (N)-fertilizers could lead to nutrient undersupply, even with increased legume cropping. As a consequence, the ability of organic agriculture to feed the world sustainably has been challenged. Muller, Schader et al.'s research work (2017) has focused on a foods system approach that

goes beyond a focus on production, yields and environmental impacts per unit output of specific commodities. Their main question is whether producing a certain total amount of food, in terms of protein and calories, with organic farming would lead to higher, or lower, impacts than producing the same amount of food with conventional agriculture. Their results have shown that adopting organic farming, when combined with complementary changes in the global food system – namely modified feeding rations and reduced livestock numbers, and drastically changing wastage patterns – can contribute to feeding more than 9 billion people in 2050, and do so sustainably. Such a combination of strategies can deliver adequate global food availability, with positive outcomes across all assessed environmental indicators, including cropland acreage demand.

To sum up, the study carried out by Muller, Schader et al. (2017) showed that organic agriculture can contribute to providing sufficient food and improving environmental impacts, only if adequately high proportions of legumes are produced, if significant reductions are made in the competition between food and feed use, livestock-product quantities and food wastage. The development of organic agriculture in the future should take up these challenges on the consumption side, and not only focus on sustainable production. Therefore, a wise combination of production and consumption measures could provide an optimal food system. All the tasks mentioned above should be implemented together and this is a great challenge, when one realizes that organic farming is nowadays carried out on only 1% (average) of useful agricultural acreage across the world – 6.5% in France, in 2018, for instance.

A political choice and societal change

Muller, Schader et al. (2017) underlined the two major changes needed to complement organic farming across the whole world: drastic reduction of all kinds of food wastage – estimated at *ca*. 30% of global available food, from the farm to the fork – and limitation of the present competition between food and feed production. About one-third of the world's arable lands is devoted to produce feed, such as soybeans, maize, wheat, etc., for livestock, while part of this production could be channelled to feed human populations. Therefore, it was recommended to reduce livestock and foodstuffs of animal origin, such as meat, fish, eggs and dairy products – this production could be reduced by more than 33%.

Christian Schader of the Research Institute of Organic Agriculture (Switzerland) stated: "The roadmap to take is a political choice and a societal change." It should be recalled that a similar prospective study had been carried out in France: the so-called scenario Afterres 2050, published in 2016 by the association Solagro, concluded that organic farming – 50% of the whole country's agriculture – could feed 72 million French people in 2050, with no increase in arable lands and at the same time halving the emissions of greenhouse-effect gases, energy consumption and water needs during the summer, and also a decrease by more than 3% of pesticide use. And here again, in the case of France, two prerequisites were underlined: the drastic reduction in overconsumption and losses, as well as a change in diet composition. "We consume two-thirds of animal proteins compared with one-third of plant proteins. We should reverse this situation

and reduce by more than 33% our consumption of foodstuffs of animal origin. That change is occurring among the consumers of organic food," underlined Philippe Pointereau, one of the co-authors of Solagro's study and in charge of the association's agro-ecology sector (Garric, 2017).

An important issue that has not been mentioned in these prospective studies is the economic feasibility of such a revolution – i.e. feed the whole world with organic agriculture and food. Will the farmers be fairly paid for their products as they are nowadays, when competition will entail a fall in the prices? Would the consumers be able to buy this organic food, which is nowadays more costly than conventional food? Philippe Pointereau, in this regard, stated: "Agriculture receives many public subsidies and it would seem logical that those funds be channelled into the sustainable production of food, with a view to minimizing external costs such as water pollution or the impacts on public health. Regarding the consumers, food could be a little more costly even though the percentage of meat and dairy products were reduced. But, taking account of the foreseeable benefits, they might be able to invest a little more" (Garric, 2017).

They are being increasingly influenced by the need to protect and conserve the environment, the expectations about food traceability or also the successful return of the trend of products "made in France". We are therefore facing a new reality: yesterday, the offer created the demand to a large extent and low prices were the primary driving force of purchases; nowadays, the consumers seem to make individual choices, driven by their own motivations. They express, through consuming or not some types of products, their societal vision. Checking this new consumer's behaviour was the objective of the French E. Leclerc Observatory of New Consumptions (*L'Observatoire E. Leclerc des nouvelles consommations*). Edouard Leclerc is the owner of a network of supermarkets and other services where prices are generally the lowest possible. In order to carry out a wide-ranging study on the new consumption behaviours, E. Leclerc has requested the French poll company IPSOS. The latter made its enquiry on a representative sample of the French population: 2,000 people, men and women, aged between 18 and 70 years, from 20 February to 3 March 2017 (see p. 111). The people polled were requested to give details about their consumption habits, but also about the drivers of their lifestyle. The results of the study can be summarized as follows:

- life choices dictate the consumption behaviours; the individuals attitude – open to the rest of the world, or looking inwards, trustworthy or anxious, hedonist or rational – is the architecture of their consumption;
- the consumer becomes more free; the new consumers freely combine their convictions, their wishes and sometimes their ambiguities in order to create their own criteria for arbitration; they can privilege individualism versus collective action, immediate or perennial satisfaction, etc.
- social and economic determinism seems to disappear; as the choices in terms of consumption have became more and more individual, and connected to choices in lifestyle, the concept of average "baskets" of purchases becomes obsolete, as well as such criteria as income or age; however, there are always "families" of consumers who consistently make similar choices, because they have a common philosophy of life and a analogous approach to the world.

The general conclusion of the study was that the consumption of French people has effectively entered a new era. Also the study suggested that five broad families of new consumers could be distinuished: the Claimants, the Besieged, the Sponsors, the Changers and the Creatives. Among the Claimants (20% of the population), pragmatism prevails when it is about feeding oneself. The priority issue is elsewhere, for example leisure (travel, vacations, etc.). They prefer to buy ready-made products which spare time (e.g. preserves, cooked meals). For them, the quality/price ratio is important, and they tend to prefer well-known brands, as well as distributors' brands. In the case of the Besieged (25% of the population), saving money and at the same time seeking social differentiation prevail, i.e. they tend to buy more than the average distributors' brands, with respect to basic products – such as preserves or canned products, dairy items, eggs, biscuits or cooked meat; but they also wish to be socially different through buying renowned brands of some foodstuffs and beverages – wines, coffees and teas, confectionery and cheeses.

The comfortable income of the Sponsors (18% of the population) enables them to make costly food expenses; they seek pleasure in their eating habits and they pay therefore attention to all food items. The provenance of the latter is more important than their organic origin, and they therefore buy from local producers. Regarding the Changers (11% of the population), their pleasure is not in the consumption behaviour, but in the many ways of consuming differently – e.g. making purchases from local producers. In order to save money, they tend to consume less, to grow their own products and to buy in bulk. The preference for organic products prevails and the quality/price ratio was inferior to the average prevailing in French people. They buy distributors' brands and sometimes they choose to purchase novel products and gastronomic items. Finally, for the Creatives (26% of the population), food purchases are part of their "pleasures." They choose to buy well-known brands and they try novel products/brands. Their consumption behaviour combines relying on nearby shops or markets, as well as on on-line orders and purchases delivered home. They prefer organic products grown or manufactured in the vicinity.

The key results of the study in terms of percentages of types of consumption are:

- the consumption behaviours are numerous – for instance, to relax (44%), to reward oneself (54%), to show one's success (26%), to make obvious one's convictions (69%) or to confirm one's personality;
- the majority of French people (88%) only buy after having compared, thought of and calculated, either to spare money or to find out the best quality/price ratio, one even to discover the product that meets their personal expectations and convictions;
- nowadays, 80% of French people think that to consume better means also to consume less;
- 69% of French people do consume the strict minimum, avoiding overconsumption;
- 79% of French people want to support a more circular economy (more barter, sales among individuals, etc.);
- human contacts are considered a primary value in the various consumption choices (shopping, leisure) – 79% of the polled people;

- 58% of French people seek food self-sufficiency, which means that are keener on manufacturing or growing by themselves the products they need, rather than buying them.

Finally, it is worth mentioning some new words concerning eating habits and consumption behaviour. For instance, "locavorism" (see p. 125) can be summarized by the phrase: eat foodstuffs produced or manufactured locally – in the neighbourhood or in the vicinity of the main consumption sites – and at the right season for fresh produce. Henceforth the preference for low carbon-footprint products and at the same time nutritious, as well as the reliance on organic-farming practices and short circuits between producers and consumers (Labro, 2017b).

Agence Bio's (Bio Agency's) Barometer of consumption and perception of organic products in France (2019)

The French market for organic food has been on an interrupted growth trajectory for years. According to the government's Agence Bio, the 2017 gain was 17%, reaching €8.3 billion (including institutional food service). The Agency Bio's Barometer of consumption and perception of organic products in France, published in February 2019 (Agence Bio, 2019), gave the following figures and percentages:

- 71% of French people consume organic products at least once a month, whereas 12% consume them every day; regional differences are not very significant;
- main reasons for consuming organic products: 69% of French people highlight health protection; 58% underline the quality and taste of the products; 56% stress environment protection; 28%, the animals' well-being and 28% like the wider availability of organic products in their usual purchase sites;
- main factors that hinder the consumption of organic products: higher cost (84%), suspicions about the real organic quality of the product (62%), lack of eating habit concerning organic food (37%), lack of an offer of products that does not correspond to the needs (27%), lack of information (23%);
- criteria of purchase of an organic product: taste (95%), price (91%), French provenance (92%), local (or vicinity) provenance (89%), the logo AB (83%);
- usual purchase places and consumers' expectations about the commercial circuits: farm (22%, 27%); market (31%, 47%), specialized shop (31%), craftsmen (26%, 49%), supermarkets or medium-sized supermarkets (81%, 70%); through Internet (15%) and when driving (16%).

The Agence Bio's Barometer also showed that:

- there are small differences between the eating habits of those not consuming organic products and those buying them; for instance, both state that they like to devote time to prepare the meals and they have a preference for homemade meals; both compare the prices before buying the products, and they check the provenance and the quality of the purchased products;

- there is a change in the eating behaviour of French people: 57% of them have changed their purchase habits as well as their food-consumption behaviour; 61% of them avoid wastage; 58% buy more seasonal products; 55% buy more fresh produce; 52% prefer to buy locally-produced items as well as those transported over short distances (circular economy); 45% cook more often and 43% are increasingly buying more organic products;
- there exist some doubts about the trust to be accorded to the information supplied on organic products; French people state they are not sufficiently informed about the provenance of the products (51%), the regulations concerning organic farming (63%) and the control of organic products (63%);
- the consumption of organic products has been taking place for less than a year among 17% of consumers; for one to five years among 56% of them; for six to 19 years among 19% of them; and for at least 20 years among 8% of them; the average duration of the consumption is seven years;
- 27% of the persons aged between 18 and 24 years have been new consumers of organic products for less than a year, compared with 17% of all the consumers of organic products; 27% of the persons aged between 18 and 24 years intend to increase their consumption of organic products during the six forthcoming months, compared with 21% of the national population; and 70% of the persons under 25 are more numerous to state that they know the European logo of organic products;
- there are seven distinct types of consumers and buyers of organic products: young urban dwellers (11%), thrifty bachelors (15%), less confident persons (13%), the first-hour convinced persons (14%), young families converted to organic food (14%), demanding and Internet-connected persons (14%) and the bio-citizens with an advocacy role (19%);
- 53% of French people think that the regulation of organic farming has become more constraining over the last five years.

Finally, the Agence Bio's Barometer indicated that regarding the purchase of non-food items, French people are buying environment-friendly dish-washing products (61%); 57% of them are also purchasing organic cosmetic and hygiene products; 44% are buying gardening tools that can be used in organic farming; and 30% of them are buying organic textiles.

Sustained growth rate of organic farming

To illustrate the very significant growth rate of organic farming, France is a good example: at the end of 2017, 36,691 farms were labeled "bio" or organic, i.e. 14% more than in 2016. This meant an acreage of 1.78 million hectares, i.e. 6.6% of total arable land. Sales of organic foodstuffs (including institutional food service) reached €8.37 billion in 2017 (Girard, 2018e). Whereas 69% of organic food consumed in France was produced in the country, organic farming and further processing created some 50,000 new jobs between 2012 and 2017. That is equivalent to an annualized gain of 9.5%. The total number of jobs in organics in France, both

farming and processing, but excluding retail, reached 134,500 at the end of 2017. So one out of every eight jobs in the agricultural sector was associated with organic farming. In Germany, the figure was one out every ten (see Agence Bio, 2019).

2018 has been a record year for organic farming in France: "The number of farmers that were compliant with organic-farming requirements reached the historic level of 6,200," stated Florent Guhl, director of the *Agence Bio*. These 6,200 farmers should be added to the 36,664 farmers registered at the end of 2017, and who decided to abandon the use of chemical fertilizers and phytosanitary compounds. The total number of this kind of organic farms reached 41,623, compared with 11,359 in 2003. Consequently, 9.5% of the French farms were certified "bio" or organic by the end of 2018. In terms of acreage a new threshold was reached in 2018: the French organic farmland expanded to 2,035 million hectares (including 1,502 million hectares that were certified strictly organic) or 7.5% of total useful agricultural acreage (SAU, French acronym for *surface agricole utile*) [*Reuters*, 2019].

All crops were included in organic farming. In 2018, the acreages of crops already certified bio, or in the process of conversion to organic farming, were the following:

- fodder	1,249,547 ha	or	10.1%	of national crop acreage
- row crops	513,783 ha	or	4.3%	
- vineyards	94,020 ha	or	12.0%	
- fruit	46,246 ha	or	23.3%	
- vegetables	29,583 ha	or	7.0%	
- aromatic, fragrant and medicinal plants	8,747 ha	or	21.1%	
- others	93,098 ha	or	7.4%	(Girard, 2019h; *Reuters*, 2019).

In 2018, it has been estimated that 68.9% of all organic products were produced locally, the rest being imported from the European Union and other countries (almost on an equal basis). For instance, wines and other alcoholic beverages were totally produced in France (99%), as well as eggs (99%) and almost milk and dairy products (97.8%). Organic fresh and processed meat were largely produced in France (94.8%), while the proportions were 77.1% for vegetables, 42.6% for fruit and only 23% for seafood and salted and cured fish (Girard, 2019h).

Weak prices for conventional grain, subsidies for organic farming and supply chain investments encouraged more crop farmers to switch, Agence Bio stated, adding that conversions were mainly outside grain belts with the highest yields. The share of organic farmland, however, was still only half of the 15% target the government had set for 2022 (*Reuters*, 2019). Although the French government made the commitment to allocate €1.3 billion to organic farming over the period 2018-2022, and "even though we are on a good trend, the speed is not sufficient to reach the objective set up in the Food Bill; *ca*. 7,000 farms per year should be converted to organic farming, in order to reach this objective," stated Florent Guhl (Girard, 2019h).

According to the data published on 9 July 2020 by the Agence Bio, there were 47,196 organic farms in France; that figure showed a 13,4% increase thanks to the certification of 5,573 farms per year. At that date, the proportion of French farms which were not using chemically synthetized fertilizers nor chemical pesticides, has reached 10%. In other words, organic farms or those in the process of being converted into organic have reached an acreage of 2.3 million hectares or 8.5% of useful agricultural acreage (Girard, 2020b). Philippe Henry, president of the Agence Bio, who has been practising organic farming since the year 2000, stated that there was a medium-term target, that is still being negociated in the framework of the Common Agricultural Policy (CAP) 2021-2027. He added: "The European Commission had set up an objective of 25% organic farming in 2030, i.e. 25% of agricultural land would be under organic farming across the European Union. The CAP should therefore be reoriented in order to allocate more resources to organic farming and allow France to become a driving force in this regard" (Girard, 2020b).

The sharp rise in organic production was helping keep pace with strong consumer demand and cap imports, Agence Bio stated. Organic food sales rose 15.7% in 2018 to €9.7 billion or US$10.9 billion, on 5% of the overall food spending by French households. That kept France as the European Union's second-largest organic food market, behind Germany which had sales of €10.9 billion. Supermarkets, which accounted for 49% of sales in 2018, drove demand by giving consumers greater access to organic food. The share of imports was stable at 31% in volume terms (*Reuters*, 2019). Regarding the detailed household purchases of organic products in 2018, the following percentages have been estimated for the whole population: 23% for grocery; 19% for fresh fruit and vegetables; 17% for dairy products; 12% for alcoholic beverages; 10% for meats; 7% for bakery products and also 7% for seafood, frozen food and some catering; and 5% for non-alcoholic beverages (Girard, 2019h).

Agence Bio, a government-backed body that promotes organic farming, played down the risk that fast growth would erode price premiums for farmers and lead to less sustainable practices, stating the sector would adjust. However, this wave of conversion to organic farming raises the issue of the subsidies needed for this difficult conversion. In the case of France, the disbursement of subsidies allocated to organic farmers has been chaotic since 2016; this was a matter of serious concern, not only for dairy- or meat-livestock husbandry, but also for large-scale crop farmers. Despite the commitment of the government to catch up, some dairy-livestock breeders had not yet received, at the beginning of 2019, the 2016 and 2017 final payments. Moreover, the state has decided to cancel subsidies to organic farmers' maintenance as of 2018 – a support that encouraged farmers to carry on organic farming after the period of three-year conversion. The agriculture ministry had nevertheless scheduled a €1.3-billion funding for a plan called "Ambition Bio" over the period 2018-2022 (including *ca*. €200 million allocated by the state and *ca*. €630 million of European aid). And, according to the Food Bill adopted by the French parliament in September 2018, the French government's objective was to provide a 20% proportion of organic foodstuffs in the meals served in the school dining halls in 2022 (Girard, 2019b).

In 2019, according to the data provided by the Agence Bio, French consumers have spent *ca*. €11.3 billion to buy organic products – with a label consisting of a white flower on a green background. This figure showed a 13.3% growth rate and it represented more than 6% of household's food purchases. The large food-distribution groups have largly benefited from this trend and their share of this profitable market reached 55%, while their annual sales grew by 18% in 2019. Furthermore, the proportion of imported organic products remained at the level of 33% and they mainly consisted of fruit and vegetables, fish, groceries and non-alcoholic beverages (Girard, 2020b).

Use of farmers' seeds

With the widespread growth of organic farming, of direct sales to consumers, of the products locally produced and of vegetable gardens, we have seen the coming back of farmers' seeds. In these production niches, the elite crop variety that grows everywhere, if its environment is made uniform thanks to irrigation and various agricultural inputs, is not the most appropriate. By contrast, what is sought is a crop variety that is best adapted to local or regional conditions and to its most suitable utilization. According to the Food and Agriculture Organization of the United Nations (FAO), after decades of erosion of crop diversity, the latter has been reduced by 75% during the 20th century. After the Second World War, agriculture has been focused on a few higher-yielding, modern varieties, that are adapted to mechanization and chemical inputs. Consequently, the farmers' varieties were collected and stored in seed banks. The number of the latter was *ca*. 1,750 across the world in 2018 and they were in charge of protecting this valuable genetic heritage (Bolis, 2018).

For instance, in Switzerland, the National Seed Bank of Changins is located on the bank of the Lake of Geneva. It was founded in 1900 by crop breeders and it stored *ca*. 13,000 crop varieties in 2018. The seeds are stored in refrigerated containers, and they are sown, on a regular basis, on small plots where can be grown, for instance, wheat ancestors or modern soybean varieties. "What is our major interest is not so much the agronomic value, but rather the conservation of genetic diversity," explained Arnold Schori, in charge of crop breeding and improvement. This diversity "is a crucial reservoir of plant traits that contributes to the future of food security: e.g. adaptation to climate change or to new diseases," he added. For instance, among the stored 6,000 wheat varieties, the teams working at Changins have found an old strain coming from the Grisons Mountains, which could resist to "snow rot" and which was used by Japanese breeders. But these seed banks have their limitations. As they are under the pressure of crop breeders, they have often chosen to focus on large-scale crops (e.g. wheat and maize) rather than on minor crops such as barley, oats and buckwheat. But "they play a very positive role when they distribute their varieties to farmers who disseminate them, thus contributing to crop diversity in the fields (Bolis, 2018).

And those seed banks are often the ultimate repository where small farmers, seed producers or crop-variety seekers can find forgotten crop varieties. Thus, every year, clients of the Swiss Zollinger Brothers company choose five varieties stored in Changins' containers and they grow them and readapt them to consumers' tastes, before commercializing them. Tulipan Zollinger, one of the company's executives, considers

that "through growing the crop in as many gardens and small farms as possible, we could reach a maximum security for the plant". The Zollingers have been the pioneers of organic or "bio" seeds in Switzerland in the 1980s, selling at that time a dozen crop varieties, collected in village gardens, monastries and cultivated plots. Since then, the four brothers of the Zollinger family have taken the reins of the company, beefed up the seed catalogue with *ca*. 450 vegetable and horticultural varieties. The latter are old or ancient ones, but always locally produced and free of any royalty. This is not the rule in the seed industry which protects its crop varieties through property rights and through forbidding or taxing "farm seeds", i.e. those stored by farmers who used to resow them during the following harvest. Despite these obstacles, the Zollinger company is doing well, because, as explained by the elder brother, Tulipan Zollinger, "our clients are the gardeners and small vegetable growers who are looking for distinct varieties, "Swiss-made", adapted to small-production systems … For instance, we sell a variety of tomato, called the pink tomato of Bern, which is difficult to grow, but is very tasteful" (Bolis, 2018).

Despite the demand of organic farming, local seed varieties or farmers' seeds are still a tiny part of the whole seed business, which is more and more consolidated – e.g. Bayer-Monsanto, Dupont-Dow and Syngenta-ChemChina make-up more than half of the world's seed market. Nevertheless, there is an obvious come back of these local seeds. For instance, in France, the network *Réseau Semences paysannes* (Farmers' Seeds Network) set up in 2003, included *ca*. one hundred organizations or associations in 2018. This network, like several similar European ones, aims to collect these seed varieties "on the farm" and thereafter redistribute them freely (Bolis, 2018).

Regulation of organic farming in the European Union; the risks of industrialization of organic-food production

The trend of consumption of organic products has drawn the attention of the agrifood groups, which are increasingly trying to seize this opportunity to widen their business. This raised the eyebrows of those promoting an organic farming that must be regulated. And this concern was even more relevant when the European Commission is completing its new draft regulation of organic farming in the European Union as of 2021. After years of negotiations, the broad framework of the draft was adopted in May 2018. Detailed regulatory measures are still to be negotiated. In this regard, the French National Organic Farming Federation (FNAB, French acronym) has issued a warning: "There will be a change of scale of organic farming. It should be developed in a harmonious way, while opposing industrial-drifting approaches," explained Guillaume Riou, president of the FNAB. The latter calls on "France and Europe to halt any trend towards the industrialization of organic livestock husbandry." The breeding of egg-laying hens was targeted. "In Italy, some organic poultry farms have a capacity of 100,000 egg-laying hens," stated David Léger, the FNAB's national secretary in charge of poultry husbandry. The FNAB has estimated that "organic breeding farms with more than 15,000 egg-laying hens had been set up in France over recent years; they represent only 2% of the farms, but already 20% of the poultry livestock. "The pressure is strong towards increasing the size of the farms, when the large foodstuff-distributor groups have made the egg as a flagship product to meet consumers' expectations" (Girard, 2019b).

The present European regulation determines the surface allocated to each hen in the husbandry building, as well as in the open space where the birds wander. This surface is higher than that allocated to a hen raised in non-organic conditions, in cages or even in "the open air." But there is no specification about the number of buildings on the same farm. The FNAB is in favour of farm-size limitation to 9,000 egg-laying hens. This option was still debated in 2019. The lack of a limit imposed on the area allocated to each animal is also true for broilers and pig breeding. France is struggling to defend its organic pig-breeding model. For instance, "raising the animals on a ground covered with straw rather than on duck-boards is more compliant with the animal's well-being. Moreover, using straw has the environmental advantage of producing manure instead of a slurry," but the suggestions proposed by France are not yet reflected in the future European regulation. Organic farmers also defend the so-called "link with the soil" for livestock husbandry, which refers to the farm capacity to supply part of the animals' feed. It seems that the European Commission approves this proposal, to some extent, because it is suggested that the proportion of animals' feed supplied by the organic farms or the "region" would be increased from 20% to 30%. It remains to define what is meant by the "region". In the case of France, the region means the whole national territory, while for Germany it means the Länder and for the Netherlands it means all continental Europe. There are many more regulatory measures to be discussed with a view to having a draft ready by mid-2020 for submission to the European Union's Member States. The important point being the likelihood of industrialization of organic farming with a view to rapidly responding to a growing market. And "the risk may be to lose the consumers' trust if organic farming does not meet their expectations," stated David Léger, the FNAB's national secretary in charge of poultry husbandry (Girard, 2019b).

Organic food: strategies of the large foodstuff-distribution networks and of agroindustrial companies

Introduction

It has been mentioned above that the organic product market enjoys a strong growth rate (e.g. +21% in 2017 in France). In addition, that of "fair-trade" products is even faster, while the sales of the so-called "super foodstuffs" (e.g. curcuma, pomegranate, spirulina, etc.) are taking off quickly. This change in the consumers' diet is the result of three interrelated causes. First of all, the importance attached to health and to the link, now better understood, between food and health. Secondly, the need for an increasing proportion of people to give a meaning to their consumption, to care about the environmental and social impact of their food purchases and more recently to express a concern about animal well-being. Finally, the lack of trust of a significant proportion of consumers vis-à-vis the "industrial" organization of the food system. This lack of trust concerns both the brands of the large-scale distribution companies or networks, as well as the blockbuster products of the agrifood industry (Moati, 2018).

The gradual increasing emphasis on this ethical approach to food purchase has been underestimated by the industrialists and distributors, who were caught by surprise about the recent acceleration of this trend that has a significant impact on their profits.

Despite the hyper-advertisement policy regarding the food brands and their suppliers, hyper- and supermarkets have great difficulties to slow down the decrease in their sales. The development of alternative foodstuff-sale circuits (such as organic shops, direct sales from the producer to the consumer and also independent specialized businesses who are recovering after decades of recession) is also a cause for this erosion (Moati, 2018).

Reactive strategy of food multinationals

Industrialists of the agrifood sector as well as the big foodstuff distributors have been trying over the recent years to adapt their offer in order to respond to the new expectations of consumers/citizens: e.g. organic products, locally-produced food, assistance to small producers. They are all committed to develop and apply policies of corporate social responsibility – sometimes ambitious. But, without significantly abandoning a model focused on massive production and low prices, they are reacting to consumers' defiance. However, a stiff change recently occurred among most of the food market's big actors, i.e. designing and implementing a programme or plan aimed at delivering healthy food or inducing better eating habits. Concrete activities may concern the elimination of a wide range of controversial food components, the support for farmers' conversion to organic farming, improvement of food traceability or creation of urban farms (Moati, 2018).

This trend was the main red thread of the *Salon international de l'alimentation* (International Food Fair, SIAL, French acronym), held in Paris-Nord-Villepinte, in the Seine-Saint-Denis department (north of Paris), from 21 to 25 October 2018. This biennial event gives an opportunity for food multinationals as well as for French small and medium-sized enterprises to display their innovative products and to sign distribution agreements. In the October 2018 Fair, there have been 800 innovations brought to the attention of visitors willing to harvest new ideas and to be inspired. The overall objective was to present a menu that suits the new consumers' requirements and appetite: "seeking an alliance between pleasure and health. And also with a concern about the impact of one's diet on natural ecosystems," stated Nicolas Trentesaux, the SIAL director (Girard, 2018h).

The 2018 SIAL demonstrated that, in this context, the agrifood industrialists are trying to renew their ties with the consumers, especially the "millennials". The latter are considered as "important prescribers" (opinion leaders), according to Pascale Grelot-Girard of Kantar, which evaluates the French consumers' eating behaviours (for Kantar, see p. 43. These millennials are those "responsible for the adoption of plant and organic products at home." They are very receptive to the opinions of the associations or organizations defending animal well-being, or even of those campaigning against meat consumption. But "What strikes me is the capacity of industrialists to respond to this large consumers' movement. Two years earlier, there were gluten-free foodstuffs everywhere. But, this year, considerable emphasis was laid on plant foodstuffs," stated the SIAL director. Even though there were only *ca*. 2.5% of vegetarians in France, 40% to 50% of French consumers are "flexitarians", i.e. vegetarians who may occasionally eat meat, or omnivores who introduce more plant products in their diet (Girard, 2018h).

This industrialists' behavioural change was obvious at the Paris Fair. For instance, among the products exhibited there, one could cite vegetarian Herta or Knacki sausages, the Bonduelle brand offering pasta with legumes, Danone with its vegetarian desserts (Alpro brand), Fleury Michon selling its brand "*Côté végétal*," the vegetarian desserts by Andros Gourmand, etc. Multinationals are trying very hard to respond to the French consumers' preferences for organic products. Thus, Danone, Mars, Nestlé, Lactalis, Coca-Cola, etc., are part of this "bio" rush: every week, there are making announcements about new brands or items with the "green-leaf" label, e.g. Danone yogurt, Ebly cereals, Herta ham without nitrite, President butter or Honest tea beverage (Girard, 2018h).

According to Information Resources, Inc (IRI), a consultancy founded in 1979 and carrying out studies and forward-looking analyses about marketing trends, sales of large-consumption products in super- and hypermarkets decreased by 0.8% in 2018 and by 1% during the first half of 2019. This information was published on 26 November 2019 online (https://www.glamourparis.com/societe/news/articles). This has been interpreted as a change in the French consumers' food-purchase behaviour. Emily Mayer, strategic director of IRI - France, has explained that an increasing number of French people prefer to buy organic foodstuffs, produced in the closest vicinity as well as more innovative products. It is precisely this consumers' approach that explains why the food-distributors' annual turnover was not negatively affected, despite the decrease in the sales of large-consumption products. The IRI indicated that "this rise of turnover during the first half of 2019 was the biggest, for the second-time, over the last five years."

IRI's analysts have proposed (see further), the concept of "demassification" in order to define the new approach of consumers regarding their food purchases. Each individual tends to consume a little less, but better in terms of health and environment protection. In other words, for many years, thanks to aggressive marketing and advertisement campaigns, French people have been purchasing the same kind of products and the price of the latter was the driving force behind their decisions. It seems that from now on, the consumers will behave differently: they do not necessarily shop in supermarkets, they are better informed about the foodstuff composition, their provenance (local or not) and ways of packaging them. This is obviously a significant warning addressed to the large food distributors "Demassification" (massification means making some products more accessible to people, whereas demassification means the contrary) probably indicates that the consumer does not just buy products of high brands; the list of brands becomes broader, and there is a fragmentation of consumption with food niches that include organic food, fair-trade products, vegan food, gluten-free and food items with less sugar, salt, antibiotics (in cooked meats). Emily Mayer explained that the consumer has become aware of the problems raised by overconsumption. For many, consuming less is another way of life that emphasizes the purchase of more organic foodstuffs or labeled products in reasonable quantities.

Another point that should be highlighted is that in 2017, according to the IRI study, among the ten large-consumption products, four of them were ranked in the category of "eating better," such as the ham without nitrite sold by Herta, "bio" margerine

without palm oil under the brand St Huber, the St Michel donut also without palm oil or the alcohol-free Tourtel Twist beer. According to the above-mentioned IRI's study, *ca*. 3,000 large-consumption products had been launched in France in 2017. But quite a number of them will not remain for a long time on the market. For instance, the big flop of "green" Coca-Cola with *stevia* as sweetener: despite the big advertisement campaign carried out by the company from its Atlanta headquarters, the sales of that "green" Coca-Cola were far from being part of a success story. "When consumers want less sugar in their beverages and when aspartame might induce cancer, the *stevia* (*Stevia rebaudiana*), consumed regularly as a sweetener by the Guarani Indians (Paraguay), seemed to be the right solution. But, *stevia* has an after-taste which many people do not like," stated Xavier Terlet, chairman and founder of the consultancy XTC. Also the consumption of insects which was touted as an ideal source of protein, failed to attract the consumers consistently. In this regard, Nicolas Trentesaux, director of the SIAL 2018, made the following comment: "You buy them once or twice, as a curiosity during parties between relatives or friends, and that is the end of it." The same comment dealt with the poor success of micro and macroalgae sold as lyophilized powder or gelules, etc. Also at the SIAL 2018, "a slow-down of the offer" of gluten-free foodstuffs was observed.

The rather fast conversion of the agrifood industry's offers raises several issues. Firstly, these big groups or multinationals had not the time, for most of them, to create organic-farming chains, for instance in France, and they behave in an opportunistic way when they are faced with the constraints of raw-material supply. For instance, the bag of "bio" Ebly cereals is stamped with the French banner; this is a "Made in France" product, which was the first step into the organic or "bio" market of a brand controlled by the American group, Mars, in partnership with the French cooperative Axéréal. But the "Made in France" trademark has its limitations. For instance, the cereals certified "bio" and packaged as bags of couscous, black quiñoa or flax seeds, are not generally produced in France. The couscous is imported from Italy, quiñoa from South America and flax seeds from the United Kingdom. Similarly, in September 2018, Nestlé launched the controversial organic version of its potato-purée flakes, under the brand Mousseline. This product was manufactured in France, but with German potatoes. Regarding ham, its "bio" certified version has little chance to be fully produced in France because the French "bio" porcine industry represented only 3% of the total herd. This is one of the food chains that is rather far from its conversion to organic certification, and large distribution groups are being supplied by Denmark. In other words, when an industrial food company tries to make organic products, these are not necessarily made in France. But one should recognize that the success of some products among health-conscious consumers is sometimes paradoxical. For instance, in hypermarkets where more spaces are devoted to cooking and restauration, an ice cream, Kinder Bueno – a brand of the Italian company Ferrero – was very successful. Although it is produced and commercialized by Unilever, Ferrero was also cheered in 2016, when it launched its Nutella B-Ready biscuit, of which the annual turnover was *ca*. €52 million during that year. But both food items are not necessarily organic (Girard, 2018h).

To sum up, the food market's big actors are being challenged to build up their legitimacy. For decades, they have been associated with the access to a rather cheap standard-quality food. Nowadays, the issue is not so much to eat more and cheaply, but to eat better. Consequently, brands and advertisements should convince the consumers they have understood their expectations and that they will modify their policy and make their powerful manufacturing capacity at the service of quality. But are they able to seriously engage into this conversion? According to Philippe Moati, a professor of economy at the Paris-Diderot University, co-founder of OBOSCO (*Observatoire société et consommation,* Observatory on Society and Consumption), who interviewed a representative sample of consumers, 50% of the latter doubted about the real will of the food-distribution networks to change their model, while 25% thought that, even if they wanted to do so, many of them will still have great difficulties to fulfil their commitment; only 15% of the interviewed persons considered that the large food-distribution networks were able to really change their policy. P. Moati indicated that consumers were even more severe when they judged the credibility of the big agrifood companies (Moati, 2018).

Organic foodstuffs: a good opportunity for big food distributors

According to the data provided by the French Agence Bio (2019), the large food distributors had sold 49% of the products labeled with a white leaf on a green background, in 2018; that amounted to €4.75 billion, or an annual increase of 22.6% compared with the 2017 figure. The annual turnover of organic foodstuffs represented 5.4% of total food turnover in 2018. The detailed data about organic-food sales in 2018 were the following (in € million): €4,478 for the large and medium-sized supermarkets; €3,096 for specialized organic-food retailers; €430 for small craftsmen and retailers; €1,135 for direct sales (online shopping); €319 for institutional catering; and €236 for commercial catering. These figures led F. Guhl, director of the Agence Bio, to make the following comments: "With the large food distributors holding almost half of the organic-product market, there was a clearcut disbalance which was responsible for the 2018 fast growth." Moreover these companies wanted to go farther: for instance, Carrefour would like to reach an annual turnover of €5 billion for its sales of organic foodstuffs in 2022, compared with €1.8 billion in 2018. E. Leclerc, another French large food distributor, anticipated the duplication of its organic-food sales in five years. Indeed, the big agrifood companies have decided to strongly advertise their organic brands. Danone made this decision in 2018, as well as PepsiCo which is offering a few organic versions of its Tropicana juices. Bruno Thévenin, director-general of PepsiCo France, made the following comment: "This offer makes up 5% to 10% of the company's sales in 2018-2019; but the demand grows faster than the offer, and therefore the problem remains the supply." It should be mentioned that PepsiCo made the decision to bottle its Tropicana juices not only in cardboard containers but also in plastic ones, because, according to Bruno Thévenin, "the consumers said they wanted more transparent containers for their juices, i.e. they wanted to *see* them." Consequently, Tropicana orange or pomelo juices will be bottled in PET plastic, which is not an environment-friendly solution: the company stated that 50% of the plastic was recycled, while the other half was not. This issue was important for Pepsico, because "Tropicana makes up 30% of its sales and it is the second beverage brand of this kind in France, just behind Coca-Cola's similar products," explained B. Thévenin (Girard, 2019i).

Other companies have made their bets on new brands so as to wisely step into this promising market. Thus, for instance, Coca-Cola has been promoting its tea beverage, called Honest, that was sold in the United States, but this was clearly mentioned on the advertisements. Also Coca-Cola reacted to its eternal rival PepsiCo through the purchase of Innocent, a brand created in the United Kingdom, widely distributed in France with the support of broad advertisement campaigns, but the latter do not mention explicitly Coca-Cola. On the shelves of the supermarkets Innocent is competing with Tropicana, thanks to a range of colours of its juices bottled in plastic containers. PepsiCo even tried to compete with several kinds of orange-juice dispensers under many brands. According to French National Interprofessional Fruit-Juice Union (UNIJUS, French acronym for *Union nationale interprofessionnelle des jus de fruits*), the cardboard-bottled juices which made up 60% of the market in 2010, amounted to less than 50% in 2018, due to the competition of plastic containers. B. Thévenin explained: "We have requested our supplier of TetraPak bottles if it could design a transparent cardboard. He replied that this was not possible". In France, the competition between PepsiCo and Coca-Cola was exacerbated by the purchase and commercialization by PepsiCo of a Spanish brand of *gaspacho*, Alvalle; the purchase was made ten years ago (2008-2009). But the brand helped PepsiCo to develop the market of cold soups in France; the product is manufactured in Spain and sold in cardboard packages. The subsequent commercial success did not go unnoticed by Coca-Cola which, in 2018, launched its *gaspachos* under the Innocent brand and sold in plastic bottles (Girard, 2019i).

Due to this steamroller, the specialized organic-food shops might lose ground. They make up 34% of the market. The first among them, in terms of size, is the Biocoop network, the annual turnover of which amounted to €1.21 billion in 2018 (+11% compared with 2017). A similar increase occurred in the case of another network, La Vie Claire, the sales of which reached €300 million in 2018. Biocoop as well as La Vie Claire, owned by the Pelen family, are among the few remaining independent traditional brands. On the other hand, the big food-distribution companies are willing to play the game with those distribution networks: e.g. Naturalia has been purchased by Monoprix, a subsidiary of the Casino group; while Intermarché has partnered with Comptoirs de la bio; and Carrefour has also bought part of the equity of a French southwestern brand called So.bio. Those who are really hurt are the independent small shopkeepers. Many of them have closed down. By contrast the circular-economy actors, which link the consumers with organic farming, maintain their position and make up 12% of organic-product purchases. As part of this circular economy, the consumer can have access to organic food, produced locally, and the farmer receives a fair price for his fresh produce (Girard, 2019h).

Reactive strategy of the large foodstuff-distribution networks

On 20 June 2017, celebrating the fifty years of existence of the first Auchan hypermarket in France, Gérard Mulliez, the founder of the group and the head of one of the country's richest families, alluded to his "militant approach" in favour of "good and healthy food, locally produced." This kind of discourse has been, since then, repeated by most of his competitors. In France, for instance, but also almost everywhere in the United States and Europe, the large food-distribution networks have tried to deeply change their

foodstuff *offer*. This was, for instance, the position of Edgar Bonte, chairman of Auchan: it will be a differentiated and local offer. According to Eric Brillant, director of the Auchan hypermarket in the city of Le Mans (centrewest of France), "the organic-foodstuff shelves have been increased by 500 m^2 and contain more than 3,000 items; a staff member of the hypermarket has been appointed to deal with that kind of offer The same E. Brillant stated: "For consumer, it is more convenient to find all the food specialties in the same place and, thus, Auchan wishes to become a leader in good and trustworthy food supply." This is a vital issue because the annual turnover of hypermarkets, all brands included, has been stagnant for several years. The historical model – large parking lots, vast warehouses and very low prices – is losing steam. The on-line distributors are increasing their share of the whole market. But even there, competition is becoming tougher. For instance, in France, associations of producers as well as platforms for direct sale, even though they remain "niche" offers, are alternatives to walking through, and buying in, a super- or hypermarket (Legendre, 2017).

"Times are changing," stated Thierry Desouches, spokesperson of the food-distribution network U (France); "It is the end of a society inherited from the 1970s, when the consumer was not concerned about environmental quality, animal well-being, as well as unreliable food ingredients"… "All this leads to raise questions and try to answer them through bringing back food authenticity and proximity with the terroir." "We have reached a period that is far from the prices war, which is in fact a struggle for market shares," added Serge Michels, president of the agency Proteins, a consultancy for distribution actors. "All profit margins have been eroded, and the real issue is where are we heading for and how to recover a new growth and to heighten the value of our products," he also stated. In fact, all the signals converge towards the fact that the demand of higher- "quality" products is not just a fashion. "Eating better is a deep trend," stated Nelly Graff, marketing director of the French food-distribution network, Intermarché. According to a poll by the Agence Bio-CSA, *ca*. 90% of French people had consumed organic products in 2016, compared with 37% in 2003. The same information source indicated that between 1999 and 2016 the sales of organic products in the French large and medium-sized shopping centres had been multiplied by seven, from €450 million to €3 billion. The large food-distribution companies had to change their offer and methods of management, e.g. they developed a wide range of foodstuffs deprived of allergenic compounds, such as lactose- or gluten-free food items, as well as the so-called "cleansed" recipes, where some ingredients, like pigments or dyes, have been eliminated (Legendre, 2017).

Again in France, the small and medium-sized agrifood companies, considered as more "nimble" and reactive than the big brands, have the full consumers' support, because of their capacity to propose such innovations as steaks with legumes, or milk- and egg-free pancakes. New locally-produced food items have been put on the shelves of supermarkets, e.g. honey harvested from hives located on the roof of the supermarket. Communication events or press releases relating to the food-item authenticity or to farmers' close vicinity, are becoming more frequent. For instance, the advertisements on the use of farmers' seeds, or on the nutritional value of the so-called "ugly vegetables" – with a shape and morphology quite different from the standard ones –, banned from the shelves of shopping centres, are examples of this new approach (Legendre, 2017).

In October 2017, the French food-distributor Leclerc set up an on-line Observatory of New Consumptions. Based on the results of a study carried out among 2,000 persons (see p. 111), this Internet site clearly indicated that from now on consumption is more than buying food items, it is an expression of a lifestyle choice." In this context, the offer of the shopping centres is evolving: for instance, in a franchised Leclerc shopping mall in Nice (southeast of France), are sold a "new generation" of products, half organic and the other half including imported traceable foodstuffs – e.g. Italian food with a slogan: "a 'bio' mindset, as well as an Italian art of life". Also, since 2015, Carrefour has been opening a dozen supermarkets Carrefour bio (2017) and has created in the city of Mons, Belgium, a "test" hypermarket where the consumer can, for instance, buy a beer brewed on the site or salmon smoked locally; these organic foodstuffs or products are displayed on the foreground of the hypermarket's shelves. On the other hand, the director of Auchan hypermarket, located in the city of Roncq, north of France, has reckoned that his 15,000-square-meter mall "has become obsolete, and in the newly-refurbished hypermarket organic products will be at the forefront, as well as non-packaged goods and fresh produce." We must "adapt ourselves!" he added (Legendre, 2017).

This reactive strategy of the large food-distribution corporations adopted across the world does not escape some criticisms. For instance, in France the Biocoop network is directly competing and sometimes fiercely with the big supermarkets – e.g. Auchan, Intermarché and Système U – which try to "greenwash" their sales. It was not therefore surprising that the marketing director of Biocoop, Mickaël Sureau, criticized the "opportunistic" approach of the large food-distributors: "They propose organic products as well as products derived from intensive agriculture. On the other hand, their organic offer is very different from ours. In their case, their suppliers are often conventional industrialists," M. Sureau seized this opportunity to underline Biocoop's commitment to fair trade, to the relocation of production as well to paying a fair price to the farmers. Indeed, Biocoop's growth rate is outstanding and many large food-distribution corporations would envy it: its annual turnover was multiplied by three in ten years, reaching €950 million in 2016 and it has been opening a new shop every week in France. But Biocoop's critical remarks have often received the following reaction from its large competitors: we are not just selling brands; we also have an ethical approach. "We have the duty to educate the consumer, it is an investment into the future corporation's sustainability as well an indication of the social model we should head for" (Legendre, 2017). In fact, according to Emily Mayer of IRI France, "there will not be a turnback because once the consumer becomes more demanding with respect to the quality of the product he/she purchases, the trend will continue. Of course nothing can be guaranteed, but one should pursue the struggle, so as to avoid a turnback. In fact, the consumer is now more informed and he/she can choose among a wider range of products."

"Eataly" in Paris

The fascinating story of Eataly began in January 2007 in Torino, Piemonte, Italy, where Oscar Farinetti's father had founded a supermarket called Unieuro. His son became very wealthy after converting his supermarket into a successful distribution chain of

household appliances (electricals); later on, this was sold to the British company Dixons Retail. Then, he decided to become involved in food marketing and he benefited from the advice of Carlo Petrini – the "apostle" of slow food – in order to create Eataly. According to O. Farinetti's opinion, the concept was inspired by the Great Bazar of Istanbul; then the project Eataly was carried out in association with the Italian businessman Luca Baffigo. An old vermouth factory located in Torino was the first Eataly store; it illustrated a simple idea: "To be a place, but not a non-place, where one can eat, buy and learn …, with products that cannot be found in a supermarket and producers who come to them to tell their story," said its initiator. Due to the success of this food-store concept, Eataly spread out in Italy and overseas. In New York, it was very successful, with an annual turnover of US$80 million or €71 million. In Japan, the experience was more complicated and the concept had to be adapted. In 2014, Eataly opened its equity to the Italian fund Tamburi Investment Partners: a 20% participation valued at €120 million. L. Baffigo also owned 20% of the shares, the remaining 60% was in the hands of the Farinetti family. The latter has been investing in agrifood chains and owned 19 companies supplying Eataly, including the renowned vineyard estate Fontanafredda, in the Barolo vineyards, near Alba, Piemonte. In 2016, Andrea Guerra, a former executive of the Italian company Luxottica – a factory of spectacles – became Eataly's CEO. The company had a turnover of €487 million in 2017, when it opened a food fair, Fico, near Bologna, Emilia Romagna. It was expected to reach a €600 million turnover in 2018 and to pursue its growth (Girard and Prudhomme, 2019).

In April 2019, a medium-sized, but still comprehensive Eataly grocery, wine shop and restaurant have been opened in the 4th district of Paris (*Le Marais*). France's capital was the 39th city where Eataly has been incorporated, after being present in 13 countries. This French version of Eataly attracts many customers, including tourists who are numerous in this historical and famous district. Furthermore, it was expected that the Galeries Lafayette department store will open a similar Eataly complex in its headquarters located in the 9th district (boulevard Haussmann) of Paris. The Galeries Lafayette Eataly will occupy three floors totalling 2,500 m^2, comprising seven restaurant spaces (with 400 seats), a supermarket with 1,600 Italian grocery products, a wine cellar including 1,200 vintages, a cooking school, a butcher's shop, a bakery and a cheese store, as well as a mozzarella-manufacturing stall. In addition, a market place selling Italian fruit and vegetables will be set up in a nearby backyard, as well as a coffee-shop. The Galeries Lafayette were expecting to welcome more than one million customers a year in this new temple of delicatessen and grocery, opened seven days a week until midnight. The Galeries Lafayette were hoping to recover their investment in three years. The annual turnover of the French Eataly was estimated at between €30 million and €45 million. Eataly is more than a simple network of stores selling Italian products; it is the combination of restaurant spaces with supermarket shelves and a place for highlighting the products' brands. Eataly is above all an atmosphere, a scenery, cuisine training courses … From Torino to New York, and through Istanbul and Dubai, the food-store concept attracts its customers thanks to "emotion, culture and entertainment," as described by Oscar Farinetti. The Galeries Lafayette may open similar stores in Paris and in other French main towns, depending on the expected success of Eataly (Girard and Prudhomme, 2019).

Organic food for all?

In France, the General Estates for Food (*Etats généraux de l'alimentation*), organized in 2017 aimed at convening a wide-ranging conference, attended by representatives of the consumers, farmers, industrialists and non-governmental organizations (NGOs), with a view to helping the country overcome a long farming crisis and initiate its ecological transition. The French president of the Republic, Emmanuel Macron, made the commitment to change the law in order to fix the food prices, starting from the production costs. He also promised to meet again in December 2017 with those attending the General Estates for Food, in order to set up a roadmap for French agriculture. Each agricultural chain was supposed to design a five-year restructuration plan – a prerequisite of €5-billion investment over five years, co-financed by the state. On the other hand, the second part of the General Estates' work, devoted to a more sustainable and healthier food, was over by the end of November 2017 (Girard, 2017d).

It has already been mentioned how the large food-distribution networks and agro-industrial companies are positively reacting to the change in consumers' behaviour. Surfing on this wave, they wanted to raise their business annual turnover. Thus, nutrition and environment-conscious consumers prefer to buy their fruit and vegetables on the farmers' markets or directly from the farmers; others shop at the nearby organic-food shop – even though the latter tend to disappear because they cannot compete with supermarkets. They may also choose to visit specialized shops, which share the values of fair trade and lay emphasis on healthier food; hence the slogan of Biocoop: "*Bio is Good*" (Girard, 2017d).

The number of environment-conscious farmers is increasing: by converting their farms to organic production, they try to overcome the crisis caused by lower prices of milk, beef, but also of cereals. In 2016, one-third of farmers had an income of *ca*. €350 per month and a significant number of them wished to adopt a more profitable kind of agriculture (see p. 119). While the French agriculture ministry's forecast was 8% of total agricultural acreage devoted to organic farming, this was not considered a sufficiently ambitious objective by the National Federation of Organic Farming (*Fédération nationale de l'agriculture biologique* – FNAB). The latter wanted that organic farming represented 20% of total agricultural acreage by 2022. Even with such an objective in mind, one should be rather far from a real shift of French agriculture to organic farming. Farmers feel that a wide-ranging extension of organic farming might lead to lower prices and a decrease in their income. However, the president of the French Republic, in a speech delivered on 11 October 2017 during the General Estates for Food, emphasized that in 2022 half of the products served in collective restaurants will be organic, or/and locally-produced foodstuffs (Girard, 2018i). On the other hand, he wondered why France produced only 0.5% of the organic pork consumed and was therefore unable to meet the demand. Therefore, France runs the risk of importing more organic foodstuffs to meet the consumers', as well as industrialists' and hypermarkets' demand, if the rate of conversion to organic farms is lower than expected. Moreover, it should not be forgotten that organic farming has not the same standards across the world (Girard, 2017d, 2018g).

We are therefore rather far from supplying organic food for all. Nevertheless, the trend toward more organic farming seems sustainable in many industrialized countries because it responds to a deep change in eating habits and consumption of healthier foodstuffs; because it is also the wish of an increasing number of consumers to reduce the impact of agriculture and livestock husbandry on the global warming and climate change. The efforts made up to now are commendable everywhere across the world and the expectations remain high regarding a significant increase in organic food. Also, in several developing or emerging countries, a significant portion of their cultivated land is devoted to organic farming, the produce of which is generally exported (e.g. Kenya, Ethiopia, few West African countries, India, etc.). But, poverty is still prevailing in many developing countries, with populations sometimes starving, more often undernourished and suffering from malnutrition. The issue is therefore: Could these populations feed themselves with healthier food, supplied or not by organic farming? Even though enough food is not available for everyone across the world, could the poor have nevertheless access to a healthy diet?

Can the poor have a healthy diet?

If, for instance, a large proportion of the French population is realizing the importance of buying and eating higher-quality foodstuffs, food purchases highlight the existing social disparities. The latter tend to increase, as mentioned by Serge Hercberg, president of the National Programme for Nutrition-Health: "The lower social classes improve their nutritional status, but much less faster than the middle classes" that have a higher purchasing power. In 2014, Boris Tavernier, a former manager of an Association for the Permanence of Traditional Farming (AMAP, French acronym for *Association pour le maintien d'une agriculture paysanne*), – a network that facilitates direct sales from the producer to the consumer – created the association called VRAC (French acronym for *Vers un réseau d'achat en commun*, or Toward a Network for Collective Purchase). The latter sells locally-produced organic products, at their net production cost, to people distinct from those "already attracted by organic foodstuffs and can buy them". For instance, he mentioned the case of almonds, harvested in organic farms and sold at €14 a kg, i.e. half the price posted in a nearby supermarket (Bouanchaud, 2017).

Michel and Nicole Darmon (2008), in their book tilted *L'Equilibre nutritionnel* (Nutritional Balance) have emphasized that a good-quality food implies the consumption of products which are not, or slightly, processed and of which the energy density is most often weak. Nicole Darmon is a researcher at the French National Health and Medical Research Institute (INSERM, French acronym), in charge of the unit "nutritional quality of food and modelling of food choices", while Michel Darmon is a biochemist. They both conducted a research work on nutritional balance. They came to a conclusion that contradicted a nutritional taboo. In the past, nutritionists used to say: "There are not good and bad foodstuffs, there are only bad diets." In fact, explained M. and N. Darmon, it is the relative balance between the nutritional qualities and defects of a foodstuff which determines if it is good or bad for health. The French researchers therefore recommended to evaluate foodstuff nutritional qualities through a score of individual adequacy with the nutritional recommendations; this score (called SAIN in

French) is an indicator of nutritional appropriateness (e.g. vitamin, mineral, fiber and essential fatty acid contents), while the nutritional defects of a foodstuff (summarized by the acronym LIM in French) should be mitigated (e.g. salt, sugar and saturated fatty acids). A good food therefore should have a moderate calorie content, a high SAIN score and a low LIM score. This is the case of non- or slightly processed foods, such as fruit, vegetables, whole meal cereals, legumes, fish and fresh dairy products. Conversely, many processed or ultra-processed foodstuffs, such as salted snacks, sugary products, fatty cooked meals, have a high calorie content, a low SAIN score and a high LIM one. It is impossible to meet individual nutritional needs with this kind of foodstuffs (Darmon and Darmon, 2008).

"It is not a complicated issue to have a healthy diet. What is more complicated is to resist the food advertisements," explained M. and N. Darmon. For instance, some allegations concerning the healthy advantage of chocolate-cereals recommended for breakfast have confused people. A product with "high vitamin content" could be on the other hand very rich in sugar. Henceforth, the importance of the new European regulation to put an explicit label concerning the health allegation of a foodstuff, only on those with a good nutritional profile. But how about those who have a small budget for their food purchases? Can they have a balanced and nutritionally good diet? (Darmon and Darmon, 2008).

"There exists a critical threshold of *ca*. €3.5 to €4 per day and per adult below which it is practically impossible to have a balanced diet," stated M. and N. Darmon (2008). Budget constraints lead the consumers and the households to buy high energy-content food, which are poor in terms of good nutrients. For instance, biscuits and chips, either sold under renowned brands or more common ones, are a source of energy that is less expensive than that of fruit and vegetables. The decrease in food diversity dictated by budget constraints has a negative impact on nutritional quality. To buy less costly foodstuffs, at least the basic ones, could be a solution for having a balanced diet at a moderate cost; because, for the same category of foodstuff, the low-cost products may not be fattier or sweeter than the expensive ones, while their cost is two or three times lower (Darmon and Darmon, 2008).

Another limitation to a nutritionally-balanced diet has to do with cooking, which for instance implies the purchase of a stove and thereafter the payment of gas or electricity bills, recalled M. Ramel, a PhD student working on the right to food at the University of Tours (centrewest of France), Huguette Boissonnat-Pelsy and Chantal Sibue-de Caigny, members of the health department of the French NGO, ATD Quart Monde. In 2016, they published the results of a vast enquiry titled: *To feed oneself when poor. Analysis and perception of people living in conditions of precarity*. They mentioned the case of families which had to consume "cold meals consisting of chips and tuna flakes" because of their low income and purchasing power; as well as the consumption of cans of ravioli among "families having financial difficulties." This study aimed to analyze the situation of people living in conditions of precarity and their perceptions of food purchase and consumption, with a view to proposing means and solutions that would enable people to have a sustainable accesss to food.

Finally, a pitfall of a healthy diet has often to do with the households' tastes. "People want to have some pleasure, because otherwise life is not very happy. One could talk of a reward provided by the food intake," stated Catherine Grangeard, a psychoanalyst in the gastro-enterology department of Montgardé Hospital, in Aubervilliers, in the northern suburbs of Paris. Some poor families try very hard to buy foodstuffs which can give them some pleasure, because they feel that organic food is tasteless: therefore, pleasure, fuelled by excessive advertisement, overtakes a healthy and balanced diet (Bouanchaud, 2017). To sum up, organic food is healthy, but rather costly – even though circular economy can make it less expensive. In the most hopeful cases, it would provide half of the diet of rather wealthy consumers in the industrialized countries by 2030 or later. But what is sure is that poor people, in both industrialized countries, and even more so in developing ones, are having and will have extreme difficulties to benefit from organic food and a healthy diet. Their low or very low purchasing power is the most obvious reason, as well as social inequities or disparities which tend to increase. Therefore, improving food intake has to do with fair economic growth and development, as well as with social and economic justice. When so much food is wasted across the world – e.g. 7.3% of purchased food was wasted in France in 2016, according to the Agency for Environment and Marshalling of Energy (ADEME, French acronym) – it is not acceptable that so many people still have an unhealthy or nutritionally-unbalanced diet. A more environment-friendly agriculture, including organic farming, can supply higher quality food, whereas good governance can help reduce social inequities and improve populations' nutrition, especially among the poor.

Organic-food consumption and cancer-risk mitigation

An epidemiological study carried out by French researchers and published in the 22 October 2018 issue of the *JAMA* (*Journal of the American Medical Association*) *Internal Medicine*, showed that in a population-based cohort of 68,946 adults, a significant reduction in the risk of cancer was observed among high consumers of organic food (Baudry et al., 2018). The researchers were affiliated to several institutions, including the French National Health and Medical Research Institute, INSERM, the National Agricultural Research Institute, INRA, and the Paris-XIII University, as well as three hospital departments. The French researchers tried to answer the following question: what is the association between an organic-food-based diet (i.e. a diet less likely to contain pesticide residues) and cancer risk? Baudry et al. (2018) sought, in the present population-based cohort study among French adult volunteers (68,946 participants – 78.0% female – NutriNet-Santé cohort), to prospectively examine the association between the consumption frequency of organic foods, assessed through a score evaluating the consumption frequency of organic-food categories, and cancer risk. The follow-up dates of the study were 10 May 2009 to 30 November 2016. For 16 products, participants reported their consumption frequency of labeled organic foods – never, occasionally, or most of the time. An organic food score was then computed (Baudry et al., 2018).

Among the 68,946 participants (mean age at baseline, 44.2 years), 1,340 first incident cancer cases were identified during follow-up, with the most prevalent being 459 breast cancers, 180 prostate cancers, 135 skin cancers, 99 colorectal cancers, 47 non-Hodgkin lymphomas (NHL) and 15 other lymphomas. High organic food scores were inversely associated with the overall risk of cancer. This cancer-risk reduction was estimated at *ca*. 25% among the group of volunteers who consumed a large proportion of organic foodstuffs, compared with those who consumed a small quantity of these foodstuffs or never ate them. Cancer-risk reduction could reach 34% in the case of post-menopause breast cancer (Baudry et al., 2018). "Of great relevance, these conclusions are consistent with the results of studies dealing with the professional exposure to pesticides," explained the American epidemiologist Philip Landrigan of Boston College, who did not participate in the study. "These results emphasize the likely link between the effect observed and the presence of pesticide residues in the diet," he added. In particular, lymphomas are blood cancers which are rather common among farmers exposed to pesticides. Philip Landrigan mentioned further "that it was the first time, to his knowledge, that from a prospective enquiry – i.e. following up a group of individuals over a long period –, a relationship has been demonstrated between organic foodstuffs in the diet and cancer risk (Foucart and Santi, 2018).

The results of Baudry et al. (2018) contrast somewhat with the findings resulting from the Million Women Study cohort including middle-aged women in the United Kingdom. In that large prospective study carried out among 623,080 women, the consumption of organic food *was not* associated with a reduction in overall cancer incidence, while a small increase in breast-cancer incidence was observed among women who reported that they usually or always consumed organic food, compared with women who never ate this kind of food. Moreover, despite population and assessment methods, similar results in that study were obtained regarding non-Hodgkin lymphoma – in the Million Women Study, there was a 21% lower risk among regular organic-food consumers compared with non-consumers. It should be pointed out that one of the main difficulties of this kind of research is to correct a possible bias or distorsion. In particular, former research had shown that the consumers of organic food had in general a healthier diet; they exercised and belonged to higher social classes. All these factors can contribute to the reduction in disease occurrence or cancer risk. The researchers could therefore correct the analysis of their results thanks to the collection of a large number of characteristics of the cohort's individuals, such as the body mass index, the level of physical exercise, the socio-professional category, the quality of the whole diet, smoking, etc. According to Rémy Slama, an epidemiologist at the INSERM and the University of Grenoble-Alpes, who did not participate in the study, "it was most likely that factors associated with lifestyle, other than the consumption of organic food, were in fact those causing the observed effect" (Foucart and Santi, 2018).

Furthermore, Philip Landrigan emphasized a bias regarding the recruitment of the cohort's individuals. The latter includes volunteers, who generally have a higher level of education than the average and a healthier lifestyle. These factors may influence the results obtained. Emmanuelle Kesse-Guyot of the INSERM who participated in the study, did not disagree with that possibility, but she thought that this kind of

recruitment "would rather subestimate the observed effect than the reverse." In fact, even those cohort's volunteers who eat the least amount of organic food, had a lesser occurrence of cancer compared with a large part of the real population. However, E. Kesse-Guyot underlined that a single epidemiological study cannot provide the definitive evidence of causality and she stated that "more studies should be carried out in order to shed more light on the effect/cause relationship." But if this association is confirmed, "public-health measures should be implemented in order to promote organic-food consumption among the whole population as a promising preventive strategy against cancer," she added. Baudry et al. (2018) suggest that the negative association observed in their study between organic-food consumption frequency and cancer risk would be explained by the following fact: prohibition of synthetic pesticides in organic farming leads to a lower frequency or absence of contamination in organic food compared with conventional food, and results in significant reductions in pesticide levels in urine. In 2015, based on experimental and population studies, the International Agency (Centre) for Research on Cancer (IARC-CIRC) recognized the carcinogenicity of certain pesticides. Emmanuel Ricard, in charge of prevention at the League Against Cancer (*Ligue contre le cancer*), commented that "a common-sense attitude will be to limit the exposure of people to pesticides and to other chemically synthesized compounds." This approach to healthier food was recommended further to the discovery in 2018 that ultra-processed foodstuffs were also a cancer-risk factor (Deschasaux et al. and Touvier, 2018; Fiolet et al., 2018; see pp. 85-86).

There is however a need for more research regarding the evidence of a close association between exposure to pesticide residues and cancer or disease occurrence. Nevertheless, a study carried out on laboratory mice and published on 25 June 2018 by researchers of the French INRA and INSERM (mostly from research units located in the city of Toulouse, southwest of France) aimed to evaluate the metabolic consequences of chronic dietary exposure to a mixture of six pesticides, commonly used in France, at non-toxic doses and relevant to consumers' risk assessment. The mixture was incorporated in a standard chow at doses exposing mice to the tolerable daily intake (TDI) of each pesticide. Compared with those fed control chow, wild-type (WT) mice fed pesticide chow had greater body weight (BW) gain and more adiposity. Moreover, these WT males fed pesticide chow exhibited characteristics of hepatic steatosis and glucose intolerance, which were not observed in those fed control chow (Lukowicz et al., 2018). The French researchers stated they were the first to demonstrate a sexually dimorphic obesogenic and diabetogenic effect of chronic dietary exposure to a common mixture of pesticides at TDI levels – these pesticides can be found on fruit and vegetables. Therefore, a pesticide cocktail to which consumers may be exposed through food intake, induced at a non-toxic dose (TDI level as defined for human exposure but adjusted to the BW of mice) in a mouse model, caused metabolic disruption consistent with diabetic status. These results question the relevance of TDI levels for individual pesticides when present in a mixture (Lukowicz et al., 2018).

VEGAN FOOD

Definitions

Vegans are those who do not consume any food derived from animals, such as meat, dairy products, and even refuse to wear clothes made of natural leather and wool. Vegans who were a few years ago quite marginal in society are gaining in legitimacy. Books and publications of celebrities like Aymeric Caron, as well as videos disseminated via the social networks, such as those filmed in French slaughterhouses by the association L214, have drawn the public's attention on vegan activists and antispecist people. But taking account of this extreme advocacy, is it possible to imagine a world without livestock husbandry? Are the production and consumption of synthetic steaks made of plant proteins an alternative to veganism? (Labro, 2017b). See further (p. 147).

According to the CRÉDOC (French acronym for *Centre de recherche pour l'étude et l'observation des conditions de vie*, Research Centre for the Study and Observation of Living Conditions, based in Paris), the consumption of butcher meat (beef, veal, lamb, pork and horse meat) in France has been reduced from 58 g to 46 g per day per adult, between 2007 and 2016 (Tavoularis and Sauvage, 2018). The CRÉDOC study was based on its monitoring system of Eating Behaviours and Consumption in France (CCAF), which estimates the consumption of meat products, upon the request of the French Interprofessionals involved in livestock husbandry and meats (INTERBEV). The analysis of the data has shown that meat consumption has been steadily falling down since the year 2000. This decrease has been shown among all generations, but it is more marked in well-off social categories and among workers. Such a trend can be explained by the price of meat – for instance, in the case of beef, the price increase was higher than the inflation rate; the health concerns; the increased awareness of the impact of this consumption on the environment, and of the animals' well-being; and by an offer that is not increasingly meeting the expectations of the new generations (Tavoularis and Sauvage, 2018).

Two typologies established in 2007 and 2016 have emphasized the changes in food diets. They can be illustrated by two opposite food trends: that against salted and sweetened foodstuffs, and that fostering modern food instead of traditional one. Younger people prevail in the trend relating to the consumption of modern and street food, while older people prefer traditional food. The CRÉDOC study's conclusion was the definition of five food profiles among the French consumers:

- those who are in a hurry, and eat a large quantity of sandwiches and pizzas, but much less fruit and vegetables, and drink soft drinks;
- those who are fond of cereals, thus having a large consumption of cereals at breakfast, of milk, rice and poultry;
- those called "basics", who consume large quantities of soups, fresh dairy products, stewed and dried fruit, and much less sandwiches and soft drinks;
- the "bon viveurs" who drink alcoholic beverages and eat legumes, cooked meats and cheese;
- he gastronomes who like raw foodstuffs and cooking. They concern more fats and condiments, but also fish, fruit and vegetables (Tavoularis and Sauvage, 2018).

The category of those consuming large volumes of alcoholic beverages, dried seeds and fruit, at aperitif time – drinks before lunch and dinner –, has disappeared in 2016 and was distributed among the "bon viveurs" and the "basics". Individuals belonging to the "basics" are those who consume the smallest quantities of meat products, especially white ham. The gastronomes who include the retired people and the well-off social categories, are those who consume the largest meat portions such as pork chops, roasted rooster, beef steak and roasted pork. Finally, regarding the "bons viveurs", who include a majority of retired persons and modest social categories, they consume dry sausage, paté de campagne and cured ham quite often, in addition to eating burgers and white ham. Thus, in 2016, the social categories where the consumption of raw and cooked meats is higher than the average, were declining. Meanwhile, the new generations, including those who are in a hurry and are fond of cereals, are consuming prepared meals, and are converting their meat consumption – eating more processed foodstuffs (Tavoularis and Sauvage, 2018).

Whether they are tempted by flexitarism – i.e. flexible vegans may eat meat occasionally, or omnivorous people who eat more plant products and meat from time to time –, veganism or vegetalism, "many consumers are often psychologically inhibited, due to a fear of a tasteless and nutritionally deficient food," explained the co-founders of the application Vegg'up, Salomé Tenenbaum and Robin Liétar. That is why, since the beginning of 2018, these two 20-year-old persons have been laying more emphasis on the fact that "veggie does not anymore mean a boring eating experience". To that end, the "Vegg'uper" has access to more than 4,000 personalized recipes, that take account of tastes (e.g. no broccolis as well as no cheese) and of food restrictions – e.g. gluten- and lactose-free food, or allergies to eggs, soybeans and hard-shell fruits (see Santolaria, 2019). For instance, one can choose: gratin hazelnuts parsnip (covered with roasted cheese), a slice of bread with pumpkin, hazelnuts and *tofu*, toasted *bulghur* (wheat) and sweet potato, and pesto of curly cabbage (kale), and also spinach lasagne, smoothie balls, banana breads and butternut moist cake. In addition, each recipe includes nutritional information such as the protein, omega-3 fatty acids and carbohydrate contents. Moreover, under the item "Advices and Tips", the vegan has access to recommendations by nutritionists and dieticians on how to design a complete meal or healthy snacks, to better digest the food ingredients, to detect the "false friends" – e.g. avoiding rice pancakes with a high carbohydrate content – and to replace eggs or add vitamin B12 – indispensable when the diet excludes all animal proteins (Duretz, 2018).

Benefits and drawbacks of vegan food

In Germany, vegan food is part of the eating habits, but it is not yet widespread despite the opening of specialized restaurants. In France, Deborah Pivan, in her restaurant in Paris, has a menu of meals made exclusively of plant substitutes. This American cook wants to show that French gastronomy can be compatible with the vegan approach to food. Only cheese remains difficult to replace by a plant-derived substitute. Vegan food is not only a way to feed oneself among city-dwellers, trendy or not; it is also an economic challenge for producers and industrialists. John Kantara, author of the documentary picture titled *Vivre végan, le nouvel éden*? (Do Live Vegan, The New Heaven? Germany, 2016, 43 minutes) takes the example of blue lupin. This plant species has a high protein content and its seeds are transformed into a milky emulsion; it is also a green fertilizer that improves soil fertility. In the northeast of Germany, many farmers have chosen to grow lupin and this choice seems to be profitable. *Ca*. 30 tons of seeds can produce 150,000 litres of "milk". Another amazing example, also in Germany (Lower Saxony), is Rügenwalder Mühle – one of the oldest enterprises of meat processing and cooked-meats trade – that started to produce plant-derived sausages; the targeted consumers being the vegans, but also the flexitarians. In 2018, these new products made up 20% of the annual turnover of the company. In the United States, in the Silicon Valley, at the laboratory level, researchers have developed synthetic meat, using biotechnological processes. They think that this new food, called 3.0, could be an alternative to the meats supplied by domestic animals (Langlade, 2018; see p. 229). Some consumers' associations have questioned the irreproachable quality of industrial vegan products as well as of their manufacturing process. These alternative products often contain chemicals that might be harmful to health. For instance, in the European Union, the alternative "milks" cannot be called as such, with rare exceptions like coconut milk. And the lobbyists of the dairy industry are very vigilant in this regard and make sure that the present norms remain unchanged in order to protect European farmers against the trend of lower milk prices (Langlade, 2018).

On the other hand, a team of American researchers, most of them belonging to the Department of Nutrition of Harvard T.H Chan School of Public Health, Boston, Massachusetts, the Channing Division of Network Medicine, Department of Medicine, Brigham and Women's Hospital, Boston, the Departments of Epidemiology and Biostatistics of Harvard T.H School of Public Health, have sought to examine associations between plant-based diets indices and coronary heart disease (CHD) incidence (Satija et al., 2017). The study included 73,710 women in Nurses' Health Study (NHS) [1984 to 2012], 92,329 women in NHS2 (1991 to 2013) and 43,259 men in Health Professionals Follow-up Study (1986 to 2012), free of chronic diseases at baseline. The researchers created an overall plant-based index (PDI) from repeated semiquantitative food-frequency questionnaire data, by assigning positive scores to plant foods and reverse scores to animal foods. They also created a healthful plant-based diet index (hPDI) where healthy plant foods (whole grains, fruit, vegetables, nuts, legumes, oils, tea, coffee) received positive scores, whereas less-healthy plant foods (juices, sweetened beverages, refined grains, potatoes, fries, sweets) and animal foods received reverse scores. To create an unhealthful PDi (uPDi), they gave positive scores to less-healthy plant foods and reverse scores to animal and healthy plant foods. The

results of the study have shown that over 4,833,042 person-years of follow-up, 8,631 incident CHD cases were documented. Satija et al. (2017) have concluded that a higher intake of a plant-based diet index rich in healthier plant foods was associated with substantially lower CHD risk, whereas a plant-based diet index that emphasizes less healthy plant foods was associated with higher CHD risk.

According to Anthony Fardet, a French researcher in preventive nutrition at the National Agricultural Research Institute (INRA), the study carried out by Satija et al. (2017) had the merit to "clearly showing the distinction between foodstuffs according to their degree of processing." In a book published in 2017 A. Fardet denounced the consumption of industrially ultra-processed foods. The book was titled *Halte aux aliments utratransformés*! *Mangeons vrai* (Stop To Ultra-processed Foodstuffs! Let Us Eat Right) and published on 15 June 2017 (Fardet, 2017). He recalled that food technology can fractionate foodstuffs and isolate their components; the latter are recombined by food industrialists which also add salt, fats, sugars and many additives, that give the artificial taste, colour and texture, lost during the fractionation process. A. Fardet qualifies those ultra-processed foodstuffs as "fake foods". For instance, bread made of white flour to which bran is added is a fake foodstuff; it has the drawback to raise the blood-glucose contents, while a whole-wheat bread (or cereal) is a true foodstuff that has not this drawback and does not fill the stomach to the same extent as the fake food. A. Fardet stated: "A foodstuff is not just a recombination of nutrients, it is a whole, and whole is better than the components." In addition, he explained that industrially ultra-processed foodstuffs generally have a negative impact on health. Finally, A. Fardet concluded that the nutritional recommendations issued for the French population should be revised; that a much more simple labeling of food, based on the degree of processing of foodstuffs, be adopted; and that industrialists be encouraged to produce foodstuffs that are least processed (Fardet, 2017).

The recommendations suggested by A. Fardet (2017) and the conclusions of the study carried out by Satija et al. (2017) would probably suit the French vegan people who want to enjoy a healthy life. According to a poll "OpinionWay" carried out for Terra eco, a non-governmental organization, on 27 and 28 January 2016 among a representative sample of 1,052 people, the total vegan population in France was almost the same as in 2012 – the year of the previous poll Terra eco/OpinionWay, i.e. 3% of total population. The number of French people who wanted to become vegans has increased between 2012 and 2016, from 4% to 10%. Among the vegans, 2% of women and 3% of men considered themselves as vegetarians. And 18% of the interviewed people aged between 35 and 49 expected to become vegetarians. For those who are more than 50-years old, that figure fell down to 10%. And 2% of the interviewed people whose household had a monthly revenue higher than €2,000, considered themselves as vegetarians, compared with 4% for those households having a monthly revenue lower than €2,000. To sum up, the OpinionWay poll has shown that: 3% of the French population (interviewed people) was vegetarian in 2016, 10% was not but expected to become vegans, while 87% were not.

For the sake of comparison, 85% Dutch people did not eat meat every day and could be considered as flexitarians. In Belgium, in the city of Ghent, a "Veggie Thursday"

had been launched in 2009: on that day of the week, all primary and nursery schools offer a vegetarian dish for lunch; since then, half a dozen Belgian cities have adopted the same measure. London had 140 vegetarian or vegan restaurants – compared with *ca*. 40 in Paris – at the beginning of the second decade of the 21st century.

Impact on the catering business

The "green" wave of organic products has been sweeping across France since 2006. The sales of organic products grew by 40% in 2016. In particular, the consumption of vegan food has also grown considerably: its annual turnover increased by 82% in 2016. The restaurant business was hit by the wave, even though the initial growth phase has been slower, with a 7% increase in terms of offer (Labro, 2018a). At the first SIRHA Green, the environment-friendly or "ecological" version of the SIRHA (*Salon international de la restauration, de l'hôtellerie et de l'alimentation*; International Fair of Catering, Hotel Business and Food), held in the city of Lyon (France) in June 2018, Gilles Fumey, a French geographer and food researcher stated: "The younger generations are much more concerned about food waste, pesticide use, incorporation of food additives, food traceability and food quality transparency. The catering professionals realize that they must change and make profound "modifications in the processing of foodstuffs, in the product offer as well as in the mindset of their teams" (Labro, 2018a). Gilles Fumey co-authored with Pierre Raffard an *Altlas de l'alimentation* (Atlas Of Food), published on 26 April 2018, by the French National Scientific Research Centre (CNRS). They describe the history of foods, cuisines and savours across the world: from maize domestication (*ca*. 4,000 years ago) to food biotechnologies of the 21st century, from the introduction of chocolate into Spain to the recent opening of Japanese restaurants almost everywhere in Europe, from the first coffee trees in Ethiopia (13th century before our era) to the Japanese *macha*, from the Greek *pitas* to the Indian *samoussas*. The history of culinary practices is part of those of cultures, exchanges and climates. G. Fumey and P. Raffard (2018) do not forget to elaborate on the ways and codes of eating habits across the whole word. And, once again, they remind us that feeding oneself is not just a physiological need, but it is a highly cultural and social act.

In a country like France, with a cooking tradition that is based on a lot of meat, quite often wasteful, the "ecological" mindset has some difficulties to prevail in the catering business. In Paris, for instance, the cosy restaurant Septime, opened in 2011, is a rare example of "eco-responsibility", regarding the supply of food ingredients – products supplied by a nearby organic farm – and the drastic reduction of wastes, their recycling and transformation into compost; but also regarding the recruitment of staff – equity between the numbers of men and women employed – and its participation in a cooperative and circular economy. In 2017, the restaurant received the Sustainability Award during the British ceremony of ranking the 50 best restaurants in the world (Labro, 2018a). But even though many cooks claim that a good product is the basis of a healthy diet, there are not yet many of them who are engaged in this "ecological" trend. According to Olivier Reneau, the editor-in-chief of the magazine *Cuisines (R) évolution*, one should not fall in the trap of greenwashing, i.e. an "ecological" make-up and advertisement with a marketing purpose. He feels that all the French prescribers of gastronomy must go farther, educate their clients, lead the way, commit themselves

on all fronts, e.g. sustainable fisheries, organic farming or production, local produce … They should propose doggy bags to their clients, as a means to avoid food wastage. All these aspects should be the new codes of trendy gastronomy. Frédéric Blousse, a successful hotel-trade businessman, in the southeast of France (Luberon), stated: "The real luxury of tomorrow will be to enjoy eating a tomato, cultivated at a distance of 30 metres, and to drink a wine produced in vineyards that could be seen through one's windows." It still remains that vegan food, despite its good perception, has not yet strongly impacted the catering business (Labro, 2018a). This is also the case of organic food, according to the data of the French Agence Bio (2019).

Challenge of fresh-food production: the case of the United States

More than half of the fresh fruit and almost a third of the fresh vegetables American buy come from other countries. The surge in imports, mostly from Latin America and Canada, flows from many other changes during the last 40 years, starting with the improvements in roads, containerized shipping and storage technology. Horticulturists developed varieties and growing practices adapted to warmer climates – enabling, for instance, blueberries and blackberries to be grown in Central Mexico (Karp, 2018).

Growth in American incomes brought greater demand for fresh produce all the year round. Immigrants brought tastes for the foods of their homelands, and in some cases (as with avocados and mangoes) these tastes have become mainstream. Foreign growers took advantage of lower labour cost. International trade agreements reduced tariffs and other obstacles to imports, while many American farmers, facing regulatory hurdles at home, have shifted production abroad, mainly in Mexico. Over the past two decades, the United States Department of Agriculture (USDA) issued roughly 100 new rules allowing specific crops to be imported from certain countries – like peppers from Peru. Crops that previously would have not been approved because they might introduce pests and diseases were allowed in through new "systems approaches" that manage those risks by combining methods like orchard inspections, sprays and bagging of fruits. Many foreign crops have recently been approved for import using these protocols, including Chinese apples and Colombian avocados. Some are going through the rule-making process (Chinese citrus, European apples) and others are under study (Brazilian citrus, Mexican guavas). As a result, the proportion of the imported fresh fruit eaten in the United States rose to 53.1% in 2016, from 23% in 1975, according to the USDA Economic Research Service. Fresh vegetable imports rose to 31.1% from 5.8%. Still, the United States remains a net agricultural exporter, with grains, soybeans, meat and nuts accounting for most of the trade surplus (Karp, 2018).

Greater availability has led to a huge increase in per capita consumption of many crops, including mangoes (up to 1,850% from 1975 to 2016), limes, avocadoes, grapes, asparagus, artichokes and squash. Yet consumption has fallen for other items – like peaches, oranges, cabbages and celery – that are still primarily grown in the United States. For consumers, the chief advantage of the import boom is the increased availability of fresh produce, particularly during the winter, when imported berries, grapes and stone fruit compete with citrus and stored apples. Many imports cost less

than domestically grown equivalents, and competition from imports keeps prices down for domestic produce. Imported produce is also sometimes fresher than the domestic equivalent. In spring, newly harvested Royal-Gala apples from New Zealand may be crunchier than the same variety from American orchards, which were picked the previous fall. And some imports are simply superb, like flavourful pink seedless-Muscat grapes from Chile (Karp, 2018).

This situation can be summarized by the fact that fruit and vegetables – a key component of a healthy diet, particularly if they are consumed in their raw form – can contribute to a healthy diet for all Americans, if the consumers' purchasing power permits. This unfortunately is not the case, because these fruit and vegetables are often rather expensive; hence the still prevailing obesity – although it seems to retreat a little – which is largely due to the so-called "junk" food and to the consumption of too much sugar, salt and fat. It might seem logical that older produce is also less nutritious, and for some compounds, such as vitamin C, contents do decline with time. But there does not appear to be any evidence that the overall nutrient content degrades significantly. From a public-health standpoint, the benefits of increased availability and consumption of imported produce outweigh any such worries, according to nutritionists. In addition, Bill Marler, a lawyer in Seattle who often represents consumers in food-borne illness cases, stated: "I do not think that produce grown outside the United States is less safe." (Karp, 2018).

In fiscal year 2015 (October 1, 2014 through September 30, 2015) the U.S. Food and Drug Administration (USFDA) has analyzed 5,989 samples in its regulatory monitoring programme; 5,572 human foods and 417 animal foods. Because the violation rates of import samples are generally higher than for domestic samples, the USFDA tests more imported commodities than domestic (4,737 import and 835 domestic samples). This represented imported human food samples from 111 countries and domestic food samples from 39 States, the District of Columbia and U.S. territories. The 2015 USFDA report, issued on 6 November 2017, indicated that 98% of domestic and 90% of imported food tested in fiscal year 2015 were compliant with federal pesticide residue limits. The levels of pesticide chemical residues in or on food generally remained well below established federal tolerances, or the U.S. Environmental Protection Agency (EPA). Additionally, no pesticide chemical residues were found in 49.8% of the domestic and 56.8% of the imported human-food samples analyzed. The USFDA found pesticide chemical residues in violation of federal tolerances in less than 2% (15 out of 835 samples) of domestic samples (USFDA, 2015). This overall result was probably not enough to justify avoiding imported produce.

There are also environmental issues: because imported fruit and vegetables typically travel farther than domestic produce from farm to table, they cause greater harm from carbon dioxide emissions and pollution. That is especially true for produce arriving by air, which is likely to be fresher and cost more than produce arriving by ship. But transport miles are just one component of environmental costs, and in some cases fruit and vegetables grown in a suitable climate overseas may require fewer farming inputs and be more generally sustainable than off-season domestic produce – cultivated, for instance, in heated greenhouses (Karp, 2018).

The increased international trade in produce has benefited many American farmers (including growers of Northwestern apples and California citrus) but harmed others (producers of Florida tomatoes and California asparagus). Most growers' organizations state trade agreements like the North American Free Trade Agreement (NAFTA) have helped American farmers on balance. Most of the advantage from exports, however, has gone to large growers. "Clearly the large shippers have benefited more from the globalization of produce," said David Runsten, policy director of the Community Alliance With Family Farmers, a California group that advocates for small farms (Karp, 2018). However, in the United States, like in many industrialized countries, there is a strong plea in favour of short circuits, from farm to fork, in order to keep the produce fresh and without much transformation or processing. These short circuits between the small farmers and consumers (circular economy) are part of a balanced and healthy diet.

Whatever the drawbacks or advantages, imports are likely to continue growing. According to a recent USDA report, fresh-produce imports will rise 45% from 2016 to 2027, implying that a decade from now, three-quarters of the fruit and almost half of the vegetables sold in the United States will be imported. In other words, Americans could get produce as they do for fish – more than 80% of which is imported. Michael Pollan, a professor of journalism at the University of California, Berkeley, does worry as imports climb: "I think it would be a tremendous loss if we were not growing a significant percentage of our produce, for reasons having to do both with quality and with the knowledge of the environment that farmers bring to a society," he stated. Consumers who agree can vote with their dollars by prizing local and domestic produce when available, and staying alert for decreased quality in less-fresh imports. The next decade or two will determine whether Americans can enjoy the advantage of an increasingly globalized supply *without losing the very real benefits of domestic products* (Karp, 2018). This will have a profound influence on the eating habits and intakes of quality and healthy food – including fast food, slow food, street food, organic and vegan food.

Societal debate around vegan food

Origin of the word vegan

The word vegan was forged in 1944 from vegetarian by Donald Watson, a British citizen who co-founded the Vegan Society. More radical than the diet excluding meat, fish and seafood, and even than the diets excluding any product of animal origin (e.g. eggs, milk and dairy products), the vegan is against any kind of animal exploitation. Therefore leather, wool, silk, as well as cosmetics and domestic cleaning products containing animal material or any material tested on animals, are banned in a vegan diet or behaviour. More generally, the word vegan utilized in the media, catering and groceries means a diet excluding foodstuffs of animal origin. The word veggie includes all kinds of vegan behaviour: vegetarians, vegetarians and vegans, defined by an increasing exclusion of animal or animal-origin foodstuffs, and derived products including those which are not foodstuffs.

Terms of the societal debate

Vegans, although still a minority group, are growing in our societies. Even in France, where the vegan wave arrived later than in Anglo-Saxon or Nordic countries, they have now their associations, restaurants, groceries and private meeting places, and even their Vegan Day (1 November) as well as their research work (vegan studies). A question is at the root of this movement and raises a societal debate: Is it recommended or is it blameworthy or reprehensible to kill animals and eat them? This question is not new, but nowadays it is enlightened by several deeds. Firstly, there are health-care arguments: meat consumption increases the risks of cardio-vascular pathologies and of some cancers. Then, environmental and ecological arguments: livestock husbandry contributes to the emissions of greenhouse-effect gases (GEG) in a very significant way, it needs the supply of half of available land across the world and consumes almost 45% of the water used in the production of food. Finally, there are moral or ethical arguments: one cannot ignore the pain inflicted to animals when they are killed or slaughtered. For decades, researchers and intellectuals have been studying this matter and came to several conclusions. Recently, the pictures of industrial livestock-husbandry conditions taken by animal protection associations using hidden cameras, have been disseminated on the Internet; the rights animals must enjoy in a democracy – e.g. they have been defined since February 2015 in the French civil code as "living beings having sensitivity" – could be broadened. Consequently, this awareness can be summarized, for instance in France, by the question: "Do we have the right to sacrifice 3 million animals every day in slaughterhouses – to which should be added tens of millions of animals being fished –, because eating meat is good"? (Vincent, 2017).

In 1846, the French Society for Animal Protection (SPA) was created in Paris, on the initiative of a physician, Dr Parisot. Similar societies had already existed for 25 years in England, Holland and Bavaria. The SPA objectives were first adapted to the concerns of the middle of the 19th century. Economic concern: a draughthorse is an asset and when it is very badly treated or even killed, it is a real wastage; to treat it well is to improve his productivity and work. Then, the hygienic concern: the calves, which are transported to the cities in atrocious conditions – tied to others, crammed in a carriage and deprived of water and food –, could become infected and provide unhealthy meat. And finally, we have a moral objective: England was indeed the first country to protect animals under human laws (Agulhon, 1981).

The French Law for the Protection of Animals was not an initiative of the government in 1850, nor of a political group or leader, it has been proposed by Jacques-Philippe Delmas de Grammont, a cavalry officer with no former political ties; he has been promoted general at the age of 54 and in charge of the Loire Department (centrewest of France) that was under siege at that time. On 22 July 1849, he was elected by this department to become a representative at the National Assembly (Second Republic). Being a cavalry officer he liked the horses and he recalled that the military rules punished those cavalrymen who badly treated their horses. In addition to his personal experience, he supported the SPA objectives, i.e.: firstly, the nasty treatment of draughthorses caused a real loss for the national economy; the very bad transport

conditions imposed on oxes and calves were a threat to the consumers' health; thirdly, seeing the suffering of animals and being cruel to them tended to make people violent and cruel – which meant that a child accustomed to bloody games would become a dangerous man. The law proposed by J.P. Delmas de Grammont was supported by the left part of the Assembly, in particular by Victor Schoelcher, whose name is associated with the abolition of slavery and who declared that the socialists were in favour of the animal-protection law. The latter was finally adopted (Agulhon, 1981).

Pierre Larousse in his *Grand Dictionnaire universel du XIXème siècle* (Great Universal Dictionary Of The 19th Century) quoted the thinkers of his time who shared his views about the protection of animals, such as Daniel Stern or Jules Michelet. P. Larousse, a well-known defender of liberal moral, secular and republican values, admitted that the animal has no rights, it cannot be judged in courts, but having a sensibility, being able to act and suffer, one cannot harm it, because "the progress in terms of morality does not only mean more justice among humans, but also more kindness and compassion, as well as the decrease in suffering across the globe." This idea that humanism includes sensitivity was so strong in P. Larousse's mind that it justified the inclusion, in the moral code or standards, of duties towards animals. And P. Larousse concluded, almost like the SPA and J.P. Delmas de Grammont did: "Those who take advantage of their superiority and torture animals are cowards and their cruelty is a threat to society" (Agulhon, 1981).

Maurice Agulhon (1926-2014) has been professor at the University of Aix-en-Provence (southeast of France) in 1969, and then at the University of Paris 1 in 1972. In 1986, he has been elected professor at the Collège de France – a very renowned higher-education and research institution of France, headquartered in Paris in the Latin Quarter. He is a historian of political concepts and institutions and he wrote the fourth volume of the monumental *Histoire de France* (France's History) published by Hachette ed., and devoted to *La République de 1880 à nos jours* (1990, The Republic From 1880 To Nowadays). He contributed to several books or compendia devoted to the history of urban and rural France, and to the history of the Provence region (southeast of France).

He has also been interested in the relationship between animal protection and humankind. In this respect, he stated that the protection of animals against humankind's violence was already an issue in the 19th century. But at that time it was not envisaged in the same terms as nowadays, i.e. during the late 20th century. He mentioned a major difference: one may say that today the protection of animals could be a branch of ecology. Despite the recent campaigns in favour of pets and animals used in vivisection, this protection primarily concerns *wild* animals, threatened with extinction by overhunting and by a global commercial and industrial exploitation. For instance, during the 19th century, in a world that was still to be explored, it would have been difficult to assume that elephants or whales were threatened with extinction. In the rural areas of France, still under the very old fears, nobody could imagine that wolves were nothing else but enemies; for the poor peasants, hunting wild boars, rabbits or partridges – all kinds of game in fact – was a right recently conquered with a view to defending their crops, increasing food supply and also to enjoying some leisure. Nobody would dare at that time to criticize the natural war existing

between humankind and the wild fauna. In the 19th century, when animal protection was discussed, this fauna was not included in the debate. What mattered was the protection of *domestic* animals that were threatened with the violence of their masters; and it was expected through stifling this kind of violence, to hold back the major violence existing between humans. Animal protection was a kind of pedagogy, it was a problem related to humankind and not to nature. To sum up, in the 19th century, the animal-protection issue was to a large extent that of violence; and the latter was one of the major topics of confrontation between strikingly opposite conceptions of the world (Agulhon, 1981).

Therefore, the idea that we have rights, but also duties with respect to living beings is a fact, and this is particularly true of domestic animals. Henceforth, the rise of the antispecist movement. The word appeared in 1970 in the writings of the British psychologist Richard Ryder. The human species has not the right to kill individuals of another species whatever may be the reason. The antispecist denies any superiority of a species over the others. All the species deserve respect and therefore not a single one may have the right to exploit another. Obviously, the antispecist does not deny the animal origin of humans, but in her or his mind the specificity of the human being consists of the moral significance of the good and the evil. For a human being, to kill is a crime, and because he or she knows that, he or she can and must decide not to kill for the sake of providing a source of food (Lestel, 2011). To sum up, considering that humans have moral rights superior to those of other animals is part of a specist attitude. The same is also true of caring more about pets than about livestock. Conversely, antispecism means that we must take account of animals' interest, whatever is their species; this implies that we must act in such a way that they do not suffer more than necessary (Vincent, 2017).

Donaldson and Kymlicka (2011) went on to propose a new agenda for the theory and practice of animal rights. Their book *Zoopolis* published in 2011 shifts the debate from the realm of moral theory and applied ethics to the realm of political theory, focusing on the relational obligations that arise from the varied ways that animals relate to human societies and institutions. They recall that in the modern era, the first Society for the Prevention of Cruelty to Animals was established in Britain in 1824, primarily to prevent the abuse of carriage horses. Thereafter, the movement has grown into a vibrant social force, with many advocacy organizations across the world. The 2008 California Proposition 2 referendum – in which 63% of voters supported a ban on the use of gestation crates for pigs, calf crates and chicken battery-cages – is one of many examples where activists have managed to focus public attention on the issue of animal welfare, and to develop a broad political consensus in favour of limiting practices of extreme cruelty.

Donaldson and Kymlicka (2011) stated that for the foreseeable future, we can expect more and more animals every year to be killed to satisfy human desires. Charles Patterson has provocatively characterized the general state of human-animal relations as an *Eternal Treblinka* (see p. 155), and there is no sign that this basic relationship will change. But in the opinion of Donaldson and Kymlicka (2011), after 180 years of organized animal advocacy, we have made no demonstrable progress towards

dismantling the system of animal exploitation. To oversimplify, much of the debate operates within one of the three basic moral frameworks: a "welfarist" approach, an "ecological" approach and a "basic rights" approach. The welfarist approach means that animal welfare matters, morally speaking, but it also subordinates animal welfare to the interests of human beings. The ecological approach focuses on the balanced functioning of ecosystems of which animals are a vital component, rather than on the fate of individual animals themselves. The shortcomings of both the welfarist and ecological approaches have been extensively discussed in the animal-rights literature, and consequently many advocates and activists have adopted an "animals rights" framework. In the strong versions of this viewpoint, animals do not exist to serve human ends: animals are not servants or slaves of human beings, but have their own moral significance, their own subjective existence, which must be respected. With respect to these basic moral rights to life and liberty, animals and humans are equals, not master and slave, manager and resource, steward and ward, or creator and artefact.

Donaldson and Kymlicka (2011) think that the animal-rights theory (ART) has been formulated in a vey narrow way: it has typically taken the form of specifying a limited list of *negative* rights – particularly those relating to ownership, murder, lockdown, torture and separation from one's family. And these negative rights apply *generically* to all animals that have some threshold level of consciousness or sentience. By contrast, the ART did not mention – or very little – the *positive* obligations we may owe to animals – such as an obligation to respect animals' habitats, or the obligation to rescue animals that are unintentionally harmed by human activities. The authors of *Zoopolis* insist on the fact that, throughout history and all cultures, there is a clear tendency to develop relationships and bonds with animals (and *vice versa*). This human contact with the animal world has usually taken a destructive from, forcing animals to participate in activities aimed at human benefit. But it is also true that this impulse for contact motivates much of those involved in the animal-advocacy movement. Donaldson and Kymlicka (2011) believe that a broader extension of ART – one that integrates universal negative rights owed to animals with differentiated positive rights depending on the nature of the human-animal relationship – provides the most promising pathway toward progressing in this field. They argue that this extension is more intellectually credible than the existing welfarist, ecological or classic animal-rights approaches to human-animal justice; it is also more politically viable, offering the resources needed to generate greater public support.

Donaldson and Kymlicka (2011) focused on the concept of *citizenship*. Human beings are not just persons who have universal human rights in virtue of their personhood; they are also citizens of distinct and self-governing societies located in different territories. Human beings have organized themselves into nation states, each of which forms an "ethical community" in which co-citizens have special responsibilities toward each other due to their co-responsibility for governing each other and their shared territory. Citizenship, in short, generates distinctive rights and responsibilities, beyond the universal human rights conferred to all persons, including foreigners. Obviously, there will be a distinction between co-citizens and foreigners. But there will also be groups that fall in-between the two basic categories: for instance, migrant workers or refugees often have the status of "denizens" rather than "citizens". There are situations where

people are neither fully insiders nor fully outsiders of a self-governing community. Indigenous people, for instance, may assert that they keep the rights to collective self-government in their traditional territory, and hence to their own citizenship, even though they are nested within larger political communities.

Today, liberalism contains not just a theory of universal human rights, but also a theory of bounded citizenship, which in turn rests upon the concepts of nationhood and patriotism, of sovereignty and self-determination, of solidarity and civic virtue, of linguistic and cultural rights, including the rights of aliens, immigrants, refugees, indigenous peoples, women, people with disabilities and children. Liberalism, today, in a complex integration of universal human rights and more relational, bounded, and group-differentiated rights of political and cultural membership. Donaldson and Kymlicka (2011) consider that the evolution of citizenship theory provides a helpful model for designing the combination of traditional ART with a positive and relational account of obligations. Many of the political processes that generate the need for a group-differentiated theory of human citizenship also apply to animals. Some animals in the *wild* should be seen as forming separate sovereign communities in their own territories; some animals are akin to migrants or denizers who choose to move into areas of human settlement (*liminal opportunistic animals*); and some animals should be seen as full citizens of the polity, because of the way they have been bred over generations in the interdependence with humans (*domesticated animals*).

To sum up, domesticated animals should be seen as full members of human-animal mixed communities, participating in the cooperative project of shared citizenship. Wild animals, by contrast, form their own sovereign communities and are entitled to the protection against colonization, invasion, domination and other threats to self-determination. Liminal animals who are wild but live in the midst of human settlements (such as crows, ravens or raccoons) should be seen as denizens, residents in our societies, but they have not the full rights and responsibilities of citizenship. To all these animals we owe respect because of their basic inviolable rights. But we inevitably and appropriately have different relations with them, with distinct types of obligations. Humans and animals are inextricably bound in a complex web of relationships, and *Zoopolis* offers an original and profound vision of how to base this complex web of relations on the principles of justice and compassion (Donaldson and Kymlicka, 2011).

On 20 October 2018 and one the same subject of *Zoopolis*, Corine Pelluchon, a philosophy professor at the Gustave-Eiffel University (department of Loire-Atlantique, centrewest of France) and member of the scientific council of the Nicolas Hulot Foundation for Nature and Humankind, was the keynote speaker of the 19th Zoopolis Conference on the theme "Co-exist with animals in the cities." This took place in the large auditorium of the City of Paris School of Engineers (EIVP, French acronym). She stressed in her lecture that while there is a massive extinction of species, public opinion is becoming more conscious of the impact of human activities on wild animal species, but also of the cruel treatment imposed on domestic animals in slaughterhouses and husbandry. When pets are more numerous and spoiled, it is just about time to have a profound thought-provoking discussion of the contradictions that dictate our behaviour towards animals. C. Pelluchon mentioned the case of liminal animals and

she compared our behaviour towards them with the way we look at migrants (i.e. the human incapacity to welcome or "to leave some place"). C. Pelluchon concluded that there is a need for the protection of *all* living beings by law against any kind of threat or cruelty imposed on them. In other words, as mentioned by the French philosopher, "animals are our otherness' teachers".

Florence Burgat (2017), a French philosopher, research director at the National Agricultural Research Institute (INRA) and working at the Paris Husserl Archives, has also analyzed the animal condition, in particular in her book, *L'Humanité carnivore* (The Carnivorous Humankind), published in 2017. She tries to answer the following questions: why are we eating meat? Have the humans always been carnivorous and are they expected to remain carnivorous? In an interview with Catherine Vincent, a journalist at the French daily newspaper *Le Monde*, she explained that recent paleoanthropological research has shown that *Homo sapiens*, like other hominids before him, had a wide range of eating habits. In particular, the proportion of plants and plant-derived foodstuffs in their diet has been underestimated for a long time, for the simple reason that these foodstuffs do not leave any trace, while animals' bones do. According to F. Burgat, prehistoric humans were more scavengers than hunters; they were above all opportunistic, eating what they could find in their vicinity. F. Burgat thinks that this conclusion has been true during the whole course of human history; excepting the regions where plant growth is impeded by weather conditions, e.g. the Great North, and where meat is the basic foodstuff. The development of agriculture has rapidly offered the possibility of eating and cooking cereals and legumes, and of having a vegetarian diet. In Ancient Greece, for instance, even though in the texts of Homer there are many accounts of animal sacrifices, it is now acknowledged that cereals provided 80% of the calorie intake of Ancient Greeks. Later on, the meat diet has been growing across Europe until the period, called by the renowned French historian Fernand Braudel, the "Carnivorous Europe" – around the 15th century. But during all historic periods, in various regions across the world, there have been attempts to adopt a vegetarian diet, e.g. in India, Japan, Korea and China; not only because of food religious taboos, but also on behalf of ethical principles regarding the respect of animal lives (Vincent, 2017).

Regarding hunting, the prehistorians used to grant it an importance that is now judged disproportionate by the majority of specialists. There was the prevailing concept that humans acquired their condition of being fully human, when they started killing animals. New datation techniques and the advent of new disciplines like paleobotany which has permitted the reconstruction of the flora of certain geological periods, have changed the scientists' view on the subject. While, according to F. Burgat, it has not been proved that hunting was the primary activity at the origin of social organization, several studies have underlined the importance of harvesting plants for food – we do not know, however, if this activity was carried out only by women. Another research subject deals with the moment when hunting became a leisure occupation. This moment occurred at different periods in human societies and it did drastically change the meaning of hunting. What happens in the human brain that may explain why a murder becomes a leisure activity? Nowadays, hunters and sportsmen claim that they are environment-friendly and that their activity contributes to the regulation of animal

populations. But it is nevertheless strange to conceive that the sight of a wild animal, e.g. a partridge flying over, a hare, a deer or doe that run away, could induce the desire to shoot them down (Vincent, 2017).

In her book, F Burgat (2017) tried to explain that the discovery of an equivalence principle within the logics of sacrifices (i.e. substituting a plant species to an animal or human victim) may finally suggest that plant-based or *in vitro* "meats" could be substituted to animal meat eaten by humans. From the philosophical viewpoint, the main chapter of F. Burgat's book is focused on the sacrifice, the ways it is practised, its various interpretations as well as on the controversial debates around it. The author mentions the continuous and massive presence of sacrifices in the ancient Rome, Greece and the pre-Islamic Arab World, ancient China, among the Aztecs, in both rituals and daily meals – to the extent that both approaches could be merged. F. Burgat tried to deconstruct the sacrifice. She considered that the supposed sacrifice's functions such as substituting interhuman violence with that imposed on animals, as well as its impact on the organization and pacification of human societies are just delusions.

F. Burgat stresses the fact that she is not writing an apologia of veganism, but it nevertheless defends it against an erroneous interpretation. Veganism should not be defined as just a food practice, because it implies a moral consideration towards animals. Can humankind get rid of a meat diet? Bearing in mind the weak moral capacities of humankind, the answer of the French philosopher is nevertheless not entirely pessimistic. The above-mentioned equivalence principle (from the bloody to the non-bloody) makes possible the replacement of a murder element by a non-murder one: for instance, the meat substitutes or *in-vitro* meat (Burgat, 2017). Nowadays, everybody should know the meaning of the word vegan, and the unbearable pictures taken by a hidden camera in several slaughterhouses by the French association L214 have resulted in a societal change: we cannot make a step back to the former situation. These pictures have been watched at the right moment, whereas researchers and philosophers (e.g. Florence Burgat) have contributed over the years to making this issue a legitimate one, through granting it a historical, philosophical and legal background (Vincent, 2017).

Present situation

Dominique Lestel, a French philosopher, has been developing for about 20 years a philosophical and ecological anthropology whose main approach is focused on the place of humans amidst other living beings and not against them. He authored many books including *Apologie du carnivore* (2011) – Apologia Of The Carnivore. According to D. Lestel, the main objective is not to eradicate meat consumption, but rather to eliminate the intensive and industrial kinds of husbandry that prevail nowadays. And he requests both the vegetarians and carnivores to join forces to combat these types of husbandry.

The opposition between vegans and carnivores has become a rift line: the "naughty" carnivore is supposed to be immoral, anti-ecological and greedy; the "nice" vegan is, by contrast, "transcompassionate" – this compassion overcomes the barriers between species –, he is environment-conscious and furthermore he is in good health.

According to D. Lestel, such opposition between vegans and carnivores remains nevertheless unsatisfactory and it should be replaced by a tripartite subdivision. Firstly, we have the "moral vegans" who form a block against a moral enemy – the "carnist" – they want to get rid of. Secondly, we have the "hypercapitalistic carnivores", which only aim to increase their profits derived from meat commercialization. And finally, there is an alliance between the "political vegans" and "ethical carnivores", who perceive that the political dimension of meat consumption should be the result of concerted actions against the serious drawbacks of industrial livestock husbandry. In this perspective, the opposition between "moralistic vegans" and "political vegans", and the distinction between "hypercapitalistic carnivores" and "ethical carnivores" seem to be more profound than the difference existing between "political vegans" and "ethical carnivores" (Lestel, 2017).

The "moralistic vegan" not only considers that meat should not be eaten, but he or she wants to impose this prohibition to carnivores; he or she also wishes to make this meat consumption a crime; he or she does not tolerate that predators feed themselves on preys. Between ethics and ecology, one has to choose ethics. By contrast, the "hypercapitalistic carnivores" are a nuisance, in the zoological sense, because they practise extreme forms of predation, whatever it costs for the community. Animal suffering, associated with dubious means to increase the benefits derived from livestock husbandry and with possible health risks – e.g. overusing antibiotics in livestock husbandry –, as well as the disastrous impact on the environment, are perceived by those "hypercapitalistic carnivores" as simple collateral damage, always minimized and sometimes denied. There are strategic alliances between "political vegans" and "ethical carnivores" that refocus the debate on the political issue of animal business and thus create a negotiation space. Such alliances are not utopian and some of them already work, like the Animalist French Party (*Parti animaliste français*), which includes a majority of vegans whose requests are not only accepted by the "ethical carnivores", but they are even part of the latters' wishes. The issue of violence imposed on animals becomes political at the community level and ethical at the individual level. Finally, in order to understand our relationship with nature, one should make a difference between those who consider this relation as a rigid one and unchangeable and those who think it is a space of permanent negotiation (Lestel, 2017).

The experience to become a vegan has been narrated by Martin Page (2017) in his book titled *Les animaux ne sont pas comestibles* (Animals Are Not Edible). In this book, the author requests everybody, being vegan or carnivore, to question his or her vision about animals and their place in society. He added that veganism is accessible and tasteful, and has nothing to do with asceticism or purity. He explained his personal experience in the following terms: "It took me several years before I made the pragmatic decision not to consider animals as foodstuffs. During these years, I read a lot and made enquiries, and I tried to get rid of the social conformism, which leads us to judge as normal our bloody relationship with animals …" "Since my childhood, I have felt that eating meat was a problem, and nevertheless I was fond of it. We can live for decades with such a paradox." This paradox was named cognitive dissonance by the Buddhist monk and philosopher Matthieu Ricard (2014), who recalled: "We keep a form of ethical schizophrenia between the care for our pets and the slaughter

of millions of pigs. We in fact kill 60 billion terrestrial animals and 1,000 billions of marine ones, each year, for our consumption. This is an unprecedented massacre in humankind's history which raises a major ethical challenge and is harmful for our societies. It may be about time to consider those slaughtered animals not as inferior living beings, but as our "co-citizens" on Earth. We sincerely claim that we are against animal suffering, but we do not change our eating habits. We acknowledge the problem, but we do not want to solve it!" This cognitive dissonance explains the increasing success of the vegan movement within which two currents are now prevailing: on the one hand, those who adopt a cheerful, creative and gourmet type of veganism, and have a guilty-free discourse; and on the other, a radical approach to strictly applying the "antispecist" thinking, i.e. it is arbitrary not to take into account the animals' interest just because they belong to species different from ours. This approach implies the prohibition of animal killings, as well as the abolition of slaughterhouses, fishing and hunting (Vincent, 2017).

This approach is that of Thomas Lepeltier (2017), an essay writer, who has become a vegan "in order to join forces against such a legal abomination"; he authored a book titled L'Imposture intellectuelle des carnivores (*The Intellectual Deception of Carnivores*, 2017). There, he loudly denounces "the thinkers of our time who have a considerable responsibility because of their role as opinion-makers", and refuse to drastically question our consumption system. "When there is not a solid and consistent reason to continue to eat meat and we must kill animals and make them suffer, the solution in terms of animal ethics is simple: we must stop eating meat, eggs and dairy products. But I have been amazed by the reluctance of many intellectuals interested in the animal issue." Such an "ideological construction" reflects "the desire to continue to have this domination relation with animals – a long standing one." And this, with the help of cognitive dissonance (Lepeltier, 2017; Vincent, 2017). The ultimate goal of T. Lepeltier was of a political nature: to declare slaughtering illegal in the medium or longer term. It must be recalled that Thomas Lepeltier has been disturbed by reading the book of the American historian and animal-rights advocate, Charles W. Patterson, tilted *Eternal Treblinka*: *Our Treatment Of Animals And The Holocaust* (2001). C.W. Patterson describes disturbing parallels between how the Nazis treated their victims and how modern society treats animals. The title is taken from a story by the Yiddish writer and Nobel Laureate Isaac Bashevis Singer: "In relation to them, all people are Nazis; for the animals it is an eternal Treblinka." The book examines the origins of human supremacy, describes the emergence of industrialized slaughter of both animals and people in modern times, and concludes with profiles of Jewish and German animal advocates on both sides of the Holocaust. C.W. Patterson follows a vegetarian lifestyle and he believes that vegetarianism can reduce violence among humans. Following a protest against Columbia University's animal cruelty, Patterson returned his doctorate to the president of the University. He believed that innocent lives had greater importance than a piece of paper. He is an active member whithin the Vegetarian Community and was a keynote speaker at the 2015 Veggie Pride Parade in New York City, where he lives.

How therefore, within this ethical and societal context, one could defend livestock husbandry?

Apologia of livestock husbandry

Jocelyne Porcher, born in 1956, is a social scientist and zootechnician, research director at the National Agricultural Research Institute (INRA). Before choosing a research career, she has been a stockbreeder and an agricultural technician. She published in 2011 a book titled *Vivre avec les animaux. Une utopie pour le XXIe siècle* (Living With Animals. Utopia For The 21st Century), where she describes how, since the 19th century, industrial capitalism has utilized livestock husdbandry with a view to making the work relationship with animals the most profitable market for "animal productions". The race to productivity which aims to ever obtain more, e.g. more milk, more piglets and lambs, and always faster and more profitable for those who invest in the meat industry, agrifood, pharmacy and genetics. This has drawn the stockbreeders in an endless race. What J. Porcher says is that "to live with animals has become a utopia … An impossible territory. Impossible because of the disproportionate and unbalanced relationship between the powerful and hegemonic industrial groups across the planet, and the individual and community goodwill of millions of farmers and citizens, who have another approach to the relation with animals, nature, work and life" (Porcher, 2011).

J. Porcher wants to tell us that there is a fundamental distinction between animal husbandry – the result of thousands of years of working with animals – and the industrial systems which emphasize a purely utilitarian and business approach to the relation with animals. Regarding the working relation with animals, the conditions of its establishment and implementation are of primary importance; in other words the quality of the link that can be created and maintained with animals is far-reaching. Regarding the stockbreeder, he obviously draws an income or revenue from his or her relationship with the livestock, but nevertheless the quality of this relationship is more important than the revenue. This relationship is above all based on the values of respect and protection; it is therefore a relationship of a deeply qualitative nature. This is what the industrial animal-production systems destroy; in those systems, a frenzied productivism leads to very harsh time schedules, as well as to morally-unbearable obligations – e.g. slaughter animals which are improductive or handicapped, and are therefore a limiting factor of the expected yields. In J. Porcher's proposal and illustrative examples, the suffering of the animals cannot be separated from the suffering of stockbreeders and other workers, who have to comply, against their will, with the norms or standards of a productive system that has lost any compassion for the animals. Thus, J. Porcher strongly opposes any tendency aiming at intensifying the industrialized production of meat (Porcher, 2011).

Finally, our relationships with animals tell us much more about ourselves and our humanity than many social analyses. While denouncing the *non-humanity* that is common in industrial slaughterhouses and the strictly utilitarian approach to the killing of animals, she insists on the need to again give a real meaning of our relationship with animals, through understanding the real meaning of stockbreeding practices, as opposed to industrial animal-production systems; a relationship based above all on conviviality (Porcher, 2011). She is therefore working with all those who oppose the industrialization of stockbreeding, who market their products locally, or on the Internet, as well as with organic farmers and stockbreeders. In 2015, she also created

an association called "*Quand l'abattoir vient à la ferme*" (When the Slaughterhouse Comes to the Farm), in partnership with a cattle breeder in the southwest of France. The association's objective was to use mobile slaughter-trucks, moving from one farm to the other, so as to avoid the stress and bruising of animals during transport as well as the violence prevailing in industrial slaughterhouses (Vincent, 2017).

New foodstuff labeling regarding animal well-being

Following the trend of labeling the nutritional value of foodstuffs (label Nutri-Score, see p. 78) there are attempts to respond to the consumers' concern regarding the breeding of domestic livestock and the decrease in animals' suffering when they are slaughtered or killed. For instance, on 5 December 2018, the French food-distribution group Casino launched a new type of labeling meat products, in partnership with three independent NGOs interested in animal well-being: Compassion in World Farming France (CIWF France), *La Fondation Droit animal, Éthique et Sciences* (LFDA, French acronym, The Foundation for Animal Rights, Ethics and Sciences) and the association *Œuvre d'assistance aux bêtes d'abattoirs* (OABA, French acronym, Bringing Assistance to Slaughtered Animals). The three NGOs have been working for about two years with Casino with a view to proposing a frame of reference based on 230 criteria – e.g. density of stockbreeding, free ranging of livestock, health care, transportation, slaughtering technique –, as well as a ranking system. Four stages have been proposed, from A to D, with green shading off into each other and a patch of grey; only the first three stages indicate a significant improvement of animal well-being. The first labeled products were expected to be put on the shelves of Casino's supermarkets on 10 December 2018. These products are part of the poultry chain that the food distributor oversees and where it can dictate the production conditions. And more precisely the label will concern six categories of products, from the whole chicken to the fillets of the *Terre et saveurs* (Terroir and Savours) – a range of Casino's brands; some already have the Red Label and the majority of products will have the new label A or B, and very few the C label (Girard and Prudhomme, 2018). These products make up 20% of Casino's poultry sales and are purchased from small farmers; they amounted to *ca*. €1 million per year (2018). But the food distributor hopes that this new labeling would be adopted on a large scale. "Our objective is also to contribute to setting up a national labeling, in the same way as, for instance, Nutri-Score. Other brands and distributors have shown their interest in our approach," explained Matthieu Riché, Casino's director in charge of the Enterprise Social Responsibility (Girard and Prudhomme, 2018).

According the European Commission's Eurobarometer 2016, *ca*. 86% of French people think that public authorities should care about the "well-being" of livestock and 51% of them wanted that this action be carried out in partnership with the companies; 72% of them wished to receive more information on the conditions of stockbreeding. On 6 March 2018, the French food distributor Carrefour launched the first food blockchain information in Europe – i.e. transmission without any intermediary; whole chickens were sold under its brand with a view to enabling the consumers to have access to a complete file on traceability, thanks to a smartphone that scans a two-dimension barcode – QR code – printed on the packaging. This commercial initiative dealt with the sales of 1 million pieces a year of poultry produced in the Auvergne region (centre

of France). At the beginning of October 2018, Carrefour started to work in partnership with a group of food companies across the world with a view to setting up, with the help of IBM, a world standard of food traceability, from the farmer or stockbreeder to the marketing places (Girard and Prudhomme, 2018).

Regarding the sales of eggs, there have been for several years three codes that aimed to guide the consumer about the conditions of poultry husbandry: Code 3 applied to chicken breeding in cages; Code 2 applied to breeding chickens without any access to their environment; Code 1 referred to eggs laid by hens raised in the farm area, while Code 0 referred to organic breeding. This kind of standard was not considered suitable by Casino and some NGOs, which aimed to avoid any kind of stigmatization. When adopting the same scale as Nutri-Score – well received by the consumers –, the above-mentioned food-distributors did not keep the same colours, from green to red. Chickens selected by Casino for this commercial operation had a green label and were given, to a large extent, the A or B ranking. These various labels may cause some confusion because the Red Label – a symbol of quality – already exists in chicken commercialization; the national authorities regulate the award of this label while taking account of the breeding conditions. However, despite this possible confusion, these initiatives aiming to set up a labeling associated with the conditions of chicken breeding have the merit to publicly raise the issue and to induce a change of mindset (Girard and Prudhomme, 2018).

Fur trade and vegan trend

The not-for-profit association People for the Ethical Treatment of Animals (PETA) has been created in 1980 with the main goal to defend animals (domestic and wild) used in the production of wool, mohair, cashmere and skins. In addition to happenings and information campaigns, the association has made considerable efforts to become a shareholder of various fashion designers, in order to act from inside their decision-making process and thus influence their policy regarding the supply of furs and exotic skins. The PETA carried out a spectacular action on 25 January 1994 when 15 of its members entered the premises of Calvin Klein (205 West 39th Street, New York City) and shouted "Compassion in the fashion" or "Fur Shame", while tagging the walls of the shop with anti-fur slogans. Fifteen days later, C. Klein decided to break off the 17-year licenses allowed to furriers that used its name and logo (Pérez, 2020).

In 1999, the antispecist association started to use another tactics: the purchase of shares of the fashion companies. The experimentation started with the American clothing company Gap; PETA became a shareholder and the San Francisco-based company made the decision to stop using fur in its clothing items. Since 2015, this approach to influencing fashion designers and companies has become more systematic. Furthermore, this approach strictly complied with the financial regulations regarding the purchase of shares of the companies. Thus, is 2015, PETA has become a shareholder of Hermès – a star of French fashion, renowned for its bags and silk scarves; then, in 2017, of the French Louis Vuitton-Moët Hennessy – LVMH group that includes Christian Dior and is nowadays the wealthiest luxury group in the world. Since 2017, PETA used both its budget and donations to become a shareholder of the following

groups: Guess, Under Armour, Capri Holdings (that owns the Versace brand as well as Michael Kors), Ralph Lauren, Target, Burberry and the giant holding Kering – the rival of LVMH and owner of Gucci, among other brands. Anissa Putois, PETA spokesperson in France, stated: "On many occasions, we have called on these companies to put an end to their harmful practices regarding the supply of animal materials used in their manufacturing process. When, after campaigns of information and several happenings, the companies were not listening to our requests, the purchase of shares became another way to make these requests applicable." Thus, on 7 April 2020, PETA has seized the opportunity of the world stock-exchange collapse to increase its share portfolio regarding LVMH and Kering and to have the right to attend the shareholders' assemblies. The two giant luxury groups had therefore to postpone these assemblies to 23 June 2020 and 30 June 2020, respectively, while they were initially scheduled to take place on 16 April and 23 April 2020, respectively (Pérez, 2020).

In 2020, PETA's participation in the equity of several fashion groups has the same goal: convince these groups to ban the use of wool, mohair and cashmere in the manufacture of their clothes. "These materials are supposedly harvested in a less cruel manner than furs or exotic skins, people think, but in fact they are not," denounced Anissa Putois, This statement has been supported by several field enquiries and impressive images taken on the spot. Despite PETA's endeavours, including its participation in the equity of the fashion and luxury groups, some brands belonging to the LVMH group still used animal skins in 2020; similarly, rabbit or fox furs were part of Fendi's clothes, as well as crocodile leather at Vuitton and snake skin at Céline – a brand of LVMH; even Hermès still commercialized bags made of exotic skins. However, some brands are taking account of PETA's requests, such as Hugo Boss – a German fashion and manufacturing group – that launched its first 100% vegan male suit in mid-March 2020. On this suit, made of linen, and upon the association's request, the label "PETA-Approved Vegan" was sticked (Pérez, 2020).

Earlier on, in November 2018, PETA has published its Fashion Awards. The list of the 2018 laureates was longer than that of 2017. At that time, only Gucci – owned by the French holding Kering – won the PETA prize, because it has decided not to use natural fur as of the spring of 2018. Also in 2018, PETA awarded its prize to Coach, Michael Kors, Diane von Fürstenberg and Burberry, which were the last fashion designers of the Fur Free Alliance – a movement opposed to the use of natural fur in clothing. In London, following the lead of Stella McCartney – a renowned militant of the animal cause – Riccardo Tisci, the artistic director of Burberry at that time, also decided to abandon the use of natural fur. This decision concurs with the aims of the vegan movement, but it was mocked by the furriers, such as the French Federation of Fur Crafts. While the French fashion designer Jean-Paul Gaultier made the decision not to use anymore natural furs – after having been targeted by PETA-castigating actions and having stated that he loved the natural fur delivered by livestock breeders. On 4 December 2018, Chanel announced that the use of exotic furs will be abandoned, on ethical grounds and also because of the lack of a rigorous traceability of their supply. Chanel will not therefore sell bags or belts made of crocodile, lizard or snake skins, and that may lead the fashion-designer to getting rid of natural furs (Garnier, 2018).

By contrast, the French Federation of Fur Crafts sneered at those "hypocrites" – fashion brands and their artistic directors – who "make marketing decisions" on "ethical" grounds, because the cause defended by "vegan-animalists" looks "very fashionable", stated Pierre-Philippe Frieh, spokesperson of the Federation. According to him, the European fur complies with the "very strict" criteria regarding the conditions of animal breeding and of their slaughter. In the breeding farms, the transformations required by the French and European regulations would cost "up to €200,000", added P.P. Frieh. For instance, the size of the cage for raising minks, foxes and chinchilla-rabbits should follow strict standards; its fence should be higher than 1.5 meter. Each piece of fur should be traceable thanks to a chip. Despite the increasing influence of the antispecist trend, the global fur market has never been so flourishing: an annual turnover of €35-billion and a 250% sales increase in fifteen years, mainly thanks to "Asian, Chinese and Korean, and Middle-Eastern clients," stated P.P. Frieh in a widely-distributed brochure of the Federation. He claimed that 2,500 jobs have been created in France and that this "noble and sustainable" material is produced in conditions that have "a less deleterious impact on environment than artificial fur." However, the suppliers of natural fur and craftsmen are frightened by the likelihood of a public prohibition, and this may explain why the sector is striving to launch a single global label in 2020: the Furmark (Garnier, 2018).

WAGING WAR AGAINST MEAT

Production and consumption of meat

Production

Over the past 50 years, meat production has more than quadrupled. In 2013, the production amounted to *ca*. 320 million tons, including 121 million tons of pork, 117 million tons of poultry, 68 million tons of beef and 14 million tons of mutton and goat meat. *Ca*. 80 million animals were slaughtered each year for that purpose. According to the Food and Agriculture Organization (FAO) of the United Nations, in 2018, more than 124 million tons of poultry have been produced, compared with 120 million tons of pork and 71 million tons of beef. Global meat production was expected to reach *ca*. 465 million tons, or even 486 million tons, in 2050.

Regionally, Asia is the biggest meat producer, accounting for *ca*. 40%-45% of total meat production. This regional distribution has changed significantly in recent decades. In 1961, Europe and North America were the dominant meat producers, accounting for 42% and 25%, respectively. In 1961, Asia produced only 12% of the total. By 2013, Europe and North America's share had fallen to 19% and 15%, respectively. This reduction in production occurred *despite* a large increase in production in absolute terms: Europe's meat output had approximately doubled over this period, whilst North American output has increased 2.5-fold. However, the increase in production in Asia has been staggering: meat production has risen 15-fold since 1961. Also, increases in output in other regions have been substantial: more than 5-fold over this period, and only 3-fold in the Caribbean. Globally, the average annual consumption of meat per person was *ca*. 43 kg in 2014. The range was from over 100 kg in the United States and Australia, to only 5 kg in India. Since then, there has been a very significant decrease in meat consumption in industrialized countries, whereas efforts have been made to foster this consumption in developing countries. In 2015, regarding the top ten exporters of beef and veal, India came first with 2.4 million tons a year, followed by Brazil (2.1), Australia (1.59), United States (1.1), New Zealand (555,000 tons), Paraguay (440,000), Uruguay (375,000), Canada (375,000), European Union (310,000) and Belarus (225,000). With respect to pork exporters, the top ten countries were: European Union (2.25 million tons), United States (2.15), Canada (1.23), Brazil (530,000 tons), China (200,000), Chile (160,000), Mexico (120,000), Vietnam (40,000), Australia (37,000) and Belarus (30,000) [Kluger, 2015].

Raising meat profits and its subsequent damage

In the United States, since Congress founded the US Meat Animal Research Center – a complex of laboratories and pastures that sprawls over 55 square miles in Clay Center, Nebraska – in order to consolidate the United States Department of Agriculture (USDA) research on farm animals, the centre has worked to make lamb chops bigger, pork loins less fatty, beef steaks easier to chew. It has fought the spread of disease, fostered food safety and helped American ranchers compete in a global marketplace (Moss, 2015b). But an investigation carried out by Michael Moss for *The New York Times* (19 January 2015) showed that these endeavours have come at a steep cost to the centre's animals, which have been subjected to illness, pain and premature death, over many years. The centre was facing another powerful trend: a gathering public concern for the well-being of animals that had penetrated even the meat industry and was trying to embrace the demand for humanly raised livestock and derived products (Moss, 2015a). See pp.146-155.

The Animal Welfare Act – a watershed federal law enacted in 1966, two years later after the center opened – aimed to minimize the suffering of animals, yet left a gaping exemption: farm animals used in research to benefit agriculture. To close that loophole, more than two-dozen companies and universities that experiment on farm animals have sought out independent overseers and joined organizations that scrutinize their research and staff. The centre's parent agency, the USDA, strictly polices the treatment of animals at slaughterhouses and private laboratories. But it does not closely monitor the centre's use of animals, or even enforce its own rules requiring careful scrutiny of experiments. As a result, the centre – built on the site of a Second World War-era ammunition depot, about two hours drive southwest of Omaha, Nebraska – has become a destination for the kind of high-risk, potentially controversial research that other institutions will not do or are no longer allowed to do (Moss, 2015a).

The New York Times' detailed investigation, including interviews of employees and revision of thousands of pages of internal records obtained under the Freedom Information Act, showed that the centre's drive to make livestock bigger, leaner, more prolific and more profitable can be punishing, creating harmful complications that require more intensive experiments to solve. The leaner pigs that the centre helped develop, for instance, are so low in fat that one in five sows cannot reproduce; centre scientists have been operating on pigs' ovaries and brains in an attempt to make the sows more fertile. Even routine care has fallen short. Of the 580,000 animals the centre has housed since 1985 at least 6,500 starved. A single, treatable disease – mastitis, a painful infection of the udder – has killed more than 625 (Moss, 2015a).

The experiments have not always helped the meat business. Industrywide, *ca.* 10 million piglets are crushed by their mothers each year, according to pig-production experts, and studies have pointed to the bigger litters as a major contributor. Not only do they generate more and weaker piglets, but the mothers have also grown larger because they are kept alive longer to reproduce. However, the USDA officials and current and

former employees vigorously defended the centre's work, which abides by federal rules on animal welfare; they said the centre has helped improve the lives of animals, and people, around the world. The centre, in fact, is used as a classroom for teaching animal care: for *ca*. 25 years, the University of Nebraska, Lincoln, has sent veterinary students into the centre for on-the-job training. Until recently, the university owned all of the animals. Centre officials stated that while even one death from starvation, exposure to disease "is too much", the fatalities have been relatively small, given the huge herd (Moss, 2015a,b).

In December 2016, P. Farrell indicated that a new report by the USDA and released by the department's inspector general, said an audit of the US Meat Animal Research Center, had found "no evidence indicating a systemic problem with animal welfare." But it called on the department of Agricultural Research Service, which is supposed to oversee the centre to establish and enforce policies to protect the animals under study. The service agreed to follow all the recommendations but one – that it starts posting the center's approved research protocols and other information online – citing concern for the safety of centre employees, who it said "have received multiple threats of physical harm from multiple sources" since *The New York Times* published an article about the centre in January 2015 (Moss, 2015a). Several weeks after the article was published, the agriculture secretary at that time, Tom Vilsack, stated an investigating panel had visited the centre and found no sign that animals were being mistreated. But he confirmed a central assertion of the article: that his department "was not adequately fulfilling its intended role" of scrutinizing experiments to make sure they minimized the animals' pain and suffering. *The New York Times*' investigation found that the centre did not have the kind of special committee the department requires to perform that work and document it; instead, the centre had turned the job over to a group of employees that often included the lead researchers for the experiments. The group could provide little evidence of its efforts. T. Wilsack stated the centre would not be allowed to start any new experimental projects until it strengthened its internal oversight and procedures. The moratorium was lifted in April 2015, after the centre created an oversight committee that passed muster (Farrell, 2016).

The USDA report takes issue with most of the assertions in *The New York Times*' investigation that cows, sheep and pigs were mistreated at the Nebraska Center, calling them inaccurate or lacking sufficient context. After the *The New York Times*' article appeared, animal-rights advocates protested outside the centre and called for its closing. A large bipartisan group of lawmakers from both houses of Congress sponsored a bill, called the Aware Act, that would extend the federal Animal Welfare Act of 1966 to protect farm animals – cows, pigs sheep and others – used in federal agricultural research. The bill never made it out of the House Agricultural Committee. The Humane Society of the United States also urged the Congress to approve the bill (Farrell, 2016). Such a controversy underlines the fact that raising the productivity of meat output and the industry's profits should not be made at the detriment of animal well-being. Vegans' claims, as well as those of all who care about domestic animals' rights should be taken into consideration.

Pork industry in the United States: unpredictable disease impact

A deadly porcine virus, the porcine epidemic diarrhea virus, or PEDv, is estimated to have killed, on average, more than 100,000 piglets and young hogs each week since it first showed up in the State of Iowa in May 2013, wreaking havoc on the pork industry. According to the USDA, the number of hogs slaughtered in 2014 was down 4.2%, to roughly 50 million from more than 52 million in the same period in 2013. Precisely how many pigs have died from the virus, which causes acute diarrhea that is virtually 100% lethal for piglets two or three weeks old, was unknown. The USDA did not require reporting of the disease until 5 June 2014, and it did not collect data on how many pigs the virus has killed, instead referring the question to the hog industry. The National Pork Producers Council did not have a figure of its own but said it had heard that *ca*. 8 million pigs have died of PEDv so far (June 2014). The USDA stated that as of 28 May 2014, nearly 7,000 samples submitted from more than 30 States to laboratories tested positive for the virus (Strom, 2014).

Waterkeeper Alliance, an environmental group, has asked the North Carolina Department of Agriculture and Consumer Services to put a mass disposal plan into effect and wanted it to declare a state of emergency. The fatality numbers, indeed, were so staggering that environmentalists have grown worried about the effects of State laws requiring the burial of so many carcasses and what that will do to the groundwater. On its website and YouTube, Waterkeeper Alliance has posted photos of dead piglets barely covered with earth and boxes overflowing with the bodies of young pigs, although it was unclear whether all were victims of the virus. The agriculture secretary at that time, Tom Vilsack, pledged US$26.2 million for a wide range of efforts to fight the virus, including the development of a vaccine. The largest amount, US$11.1 million, was to be allocated to hog producers with infected herds to enhance their safety practices. Michael Yezzi, proprietor of Flying Pigs Farm in New York State, indicated that farmers suspected that the virus arrived on a truck from Pennsylvania. "It is a big concern … we have to make sure the farms we are working with do not have the virus, because it is going to kill everything under a certain age. Nobody wants to lose 10% to 20% of their yearly supply of pigs, whether that would be 150 for someone like me or 15,000 for someone in Iowa" (Strom, 2014).

Regarding prevention, at the Hord Livestock Company in north-central Ohio, for instance, trucks returning from feed deliveries are cleaned and disinfected and then the trailers are baked to 160°C for 10 minutes. Drivers wear disposable bootees, and farm supervisors are not allowed to travel between Hord's farms. And yet the company had just finished the four- to five-month process of eliminating the virus from one of its farms and was working to disinfect another and build up its sows' immunity so they could pass it on to their piglets in their colostrum (Strom, 2014). This episode of deadly viral disease drove up the price of bacon and center-cut pork chops sold in the United States by more than 12% in May 2014, compared with the same period one year earlier, according to the Bureau of Labor Statistics. In fact, the prices for bacon rose more than 15% and pork chops were up almost 13% (Strom, 2014). This example shows, among many others that happen periodically in the livestock breeding and meat-production industry across the world, that the output of meat may suffer ups

and downs, although it seems to increase globally. The impact due to diseases and epidemic outbursts is not only on the prices paid by the consumers, but also on the living conditions of farmers and livestock breeders.

African swine fever (ASF) in China and its impact on the global food chain

On 9 may 2019, the FAO's Animal Production and Health published a report tilted *African swine fever* (*ASF*) *China situation update*. African swine fever (*ASF*) is a fatal animal disease affecting pigs and wild boars up to 100% mortality. Since the China Ministry of Agricultural and Rural Affairs (MARA) confirmed its first African swine fever (ASF) outbreak in Liaoning Province on 3 August 2018, 129 ASF outbreaks have been detected in 31 Provinces/Autonomous Regions/Municipalities. MARA reported on 23 April 2019 that 1,020,000 pigs have been culled in an effort to halt further spread. The FAO report explained that the government set a 10 km buffer zone around the epidemic zone. A strict movement control of live pigs was introduced, and live-pig markets in infected provinces and adjacent provinces were closed. Studies showed that 62% of the first 21 ASF events in China were related to swill feeding. Directives on banning swill feeding to pigs and record keeping of livestock transportation vehicles was updated. Epidemiological studies of 68 outbreaks revealed three major causes of ASF-virus spread: 46% by vehicles and workers without disinfection, 34% by swill feeding and 19% by transport of live pigs and their products across the regions. In March 2019, MARA updated regulations on pig slaughterhouses: before May 2019, provinces that do not meet the animal epidemic prevention requirements, shall immediately stop production and rectify their conduct before July 2019 to continue to slaughter hogs. If ASF is detected, the slaughtering enterprise should stop production for 48 hours, then apply for evaluation to resume production. If ASF virus nucleic acid were detected in products that were sent out from a slaughterhouse due to misconduct, the slaughter enterprises needed to recall the same batch, and the activities should be suspended for at least 15 days.

FAO recommendations to contain the ASF have been the following:

- application of strict biosecurity measures specific to the different swine-producing sectors including frequent cleaning and disinfection of farms, pigsties, transport vehicles and improved husbandry practices and production systems;
- strengthening surveillance and monitoring of transport of live pigs as well as pork products;
- good communication and coordination with swine commercial sector and swine farmers are essential to strengthen cooperation in ASF prevention, detection and control; awareness and training of all stakeholders, from veterinarians to farmers, intermediaries and other value-chain actors is needed;
- communication to public is to be in place to avoid the rumours leading to food-safety perceptions and consumption disruption;
- farm registries, animal identification and censuses are essential to enable animal-health interventions;

- prohibition of swill feeding where feasible; highly regulated where not;
- strengthening proper disposal of food waste (food services, airports, seaports) which may contain uncooked pork products;
- outbreak control strategies need to be developed in consultation with the private sector (pig producers and allied industries, such as transport, feed operators) for improved disease management options and compliance.

According to the Dutch agricultural bank, Rabobank, and its senior analyst-animal protein, Christine McCracken, expected losses in the world's largest hog herd might be up to 50% by the end of 2019. ASF was affecting at that time an estimated 150-200 million pigs. "Half of the world's pigs are in China and half of those are now eliminated we think. Roughly a quarter of the world's pigs have now perished," stated C. McCracken. "That is a huge loss. It will leave the world quite obviously short of protein. It is something that should be a big factor as we move into 2020." C. McCracken said she had never seen anything like this in the protein industry and does not expect to ever see anything like this again. "It has not stopped. It has been a year this week (6 August 2019). I think a lot of people thought of it as one and done. It hit and then we have moved on. But in fact, we continue to see huge outbreaks and now in more pig-dense regions, which is a concern because they have not been able to keep it out, even in areas with tighter biosecurity." On 22 April 2019, the losses amounted to 1.2 million animals, either dead or slaughtered as a preventive measure, according to MARA estimates. "Making the situation even more challenging, the disease is spreading into South-East Asia causing additional production losses," C. McCracken stated. The disease has spread to Vietnam – the world's fifth-biggest producer of pork – where production losses were expected to exceed 10%. ASF has also entered Cambodia and could move further into South-East Asia, with more production losses to follow.

China is the world's biggest consumer of pork (*ca*. 55 million tons in 2017). Although producers should dispose of pork properly during ASF outbreaks, C. McCracken stated a lot of that meat is going into freezers in China. "All that pork needs to be consumed. The freezers are full, consumption of pork is down, and there are some concerns on their part with safety of that pork. We just have a lot of pork in China and until all of that is consumed, we are not going to be shipping as much as you might expect," she explained. She predicted more pork will be shipped in front of Chinese New Year and the first part of 2020. The US National Pork Producers Council stated that this opportunity is one of the greatest opportunities for pork producers that they have ever seen. C. McCracken agreed, but she added that it was an opportunity for everyone – pork, chicken, beef and plant-based protein – to supply the need for protein. The ASF virus is innocuous to humans, but it spreads very easily and rapidly in livestock facilities, and it can be transported by humans or contaminated-products from one region to another. Because over half of China's breeding herd is gone and there is no cure or vaccine for ASF, it will be really hard to repopulate, according to C. McCracken. Without any control for ASF, there is a lot of risk in rebuilding. "I think it is going to be a few years until they can rebuild, but the issue is that they continue to lose pigs. Those numbers are going to get small and the smaller they get, there are fewer pigs that they can lose at that point."

Global pork prices continued to rise, as protein shortfalls intensify competition for a shrinking supply, according to Rabobank (November 2019). Pork prices have hit record highs in some regions, while trade barriers continue to limit the upside in the United States and Canada. Prices will continue to increase through the fourth term of 2019 and into 2020, as markets work to balance supply and demand. In China, in the most productive regions, such as the northeast, pork prices fell down, because many breeders sent their animals to slaughterhouses, fearing that their animals would become sick – in the Shandong province, the most seriously affected region, the livestock numbers collapsed by 41% in 2019 compared with 2018. This has created a disbalance because of an overabundant offer; furthermore, breeders could not sell their products to other provinces. Thereafter when the stocks had been exhausted, pork prices started to rise: +14.4% in April 2019, after a growth of +5.1% in March 2019, according to the National Bureau of Statistics. The subsequent result was an increase of inflation in food prices (+6% in April 2019). In the south of the China, the provinces of Guangdong and Guangxi, which were affected by the disease later on, were still in a stage of declining pork prices (Leplâtre, 2019a,b). According to Christine McCracken, the prospects were bleak: "The peak of pork prices would occur at the end of 2019 first quarter or at the beginning of 2020, when the meat stocks will be exhausted, and because it will be difficult for China to restore the numbers of herds." The MARA was foreseeing a 70% increase in pork prices during the second half of the year 2019, compared with 2018.

In the United States, record hog slaughter is weighing on markets, depressing producer returns. Productivity gains continue to outpace expectations, adding further stress to an oversupplied domestic market. Robust exports are absorbing much of the production increase, yet have been unable to fully keep pace. Although American pork exports are taxed (+62% compared with 12% usually), because of the commercial conflict with China, there was a surge in exports to the Celestial Empire – the latter had not many options because it consumed more than the total quantity of pork exported by the rest of the world. Europe remains the key supplier of pork to the global markets. Brisk exports of pork to China and other parts of Asia helped support a 31% increase in prices and near-record margins. Reports of ASF in Europe have mostly affected feral swine populations, along with sporadic commercial cases. Brazil's pork exports to China continued at a strong pace and were 33% higher than in 2018. Strong demand had driven a 17% improvement in price (US$2,297/ton) and a rebound in margins. According to a French importer of meat from Brazil into China, "the market took off very rapidly after the Chinese New Year in February. That is why pork prices are becoming higher in Europe, Brazil and the United States, due to speculation. Now most of the large countries are exporting twice the quantities of meat to China than usually" (Leplâtre, 2019a).

Impact on the global food chain

The first impact of ASF outbreaks across China was recorded among the French and European hog breeders. At the pork market of Brettany in France (ubicated in Plérin, department of Côtes-d'Armor, northwest of the country), the price of pork carcass reached €1.451 per kg on 13 May 2019. That meant an increase of more than 20% over

two months. This rise was even higher in the German and Spanish markets. The main cause of this impact on prices was the drastic reduction of Chinese pig livestock. The slaughter of pigs had a local impact at the beginning of the crisis, due to the oversupply of meat, but later on the decrease in meat stocks was followed by an increase in pork imports. And this explained the rise in pork prices. French and European breeders who produce a total of 24 million tons of pork were of course benefiting from the rise in prices – that they had never known since 2017. On the other hand, the processing industry of cooked meats also wished to transfer this unexpected price rise to the sales of various products distributed in the supermarkets (Girard, 2019g).

The second impact would be an increase in poultry or beef price. Global production of poultry is slightly over that of pork. Out of the 335 million tons of meat produced across the world, 37% are derived from poultry compared with 36% for pork. Its share in the global trade is even more important: 41% compared with 26%, reaching a total of 34 million tons. The forecast may be that Chinese consumers would consume more poultry meat if pork would become less available. Hence also a possible rise in prices. The Brazilian meat producer BRF had already announced a leap of 60% in poultry prices in Brazil. The American meat producer Tyson Foods stated, at the beginning of May 2019, that ASF "may have an impact on the global protein-producing industry, at an unprecedented level in history. "Its Brazilian competitor JBS (beef, poultry and pork) also seemed to be well placed to benefit from the increased demand in meat and subsequent exports to China (Girard, 2019g).

The third impact is on the fall down in soybean prices. China is the world's biggest importer of soybeans; half of its imports are used to feed its large herds of pigs. Consequently, the reduction in the number of these herds meant a lower consumption of feedstuffs. It was not therefore surprising that the bushel of soybeans reached its lowest price in a decade and was traded for US$8 (or €7.13) at Chicago's stock exchange. Regarding the United States, the taxes imposed on the soybean exports to China by the American administration provoked an outcry of American farmers, especially when abundant harvests were bringing down the price of the commodity. As a result the American administration had to provide an assistance of *ca*. US$7 billion or €6.26 billion to soybean producers, affected by the China/United States trade conflict. Conversely, the fall in soybean prices was a good opportunity for the breeders of poultry or hogs, who could therefore lower their production costs (Girard, 2019g).

Decrease in meat consumption

The top five consumers of beef and veal (in thousands of tons) were in 2015: United States, more than 11; Brazil, almost 8; European Union, 7.2; China, 7; and Argentina, more than 2. The top five consumers of pork (in thousands of tons) were in 2015: China, 59; European Union, 20; United States, 9; Brazil, 4; Russia, 4. The average amount of red meat consumed by Americans reached 71.1 LB, i.e. *ca*. 35.5 kg per person and per year in 2015. And 60% of the meat consumed by Americans falls into the "red meat" bucket; about 22% of it is processed (Kluger, 2018). In most studies, processed meat is treated as one category of food, regardless of whether it is from white meat, like turkey bacon, or red like pork. Some processed meats include hot

dogs, packaged turkey, sausages, corned beef, pepperoni, beef jerky, canned meat, chicken nuggets, bologna and charcuterie. Processed meat made from white meat has one potential advantage since it does not have as much heme iron (Kluger, 2015).

In France, the consumption of meat per year and per inhabitant grew from 77.6 kg carcass equivalent (kg.ec), including the non-edible parts such as bones, to 94.5 kg.ec, between 1970 and 1998. This consumption has decreased since then, to reach 86 kg.ec in 2014, according to the 2015 data of France Agrimer – a statistical and information organization for agriculture, fisheries and aquaculture. The consumption of all kinds of meat has been decreasing, except that of poultry. Pork is the most consumed meat (38% of total), ahead of beef (29%), poultry (29%) and mutton and goat meat (4%) [Benkimoun, 2015]. There have been several studies, enquiries, poll surveys and research on the causes of this decrease in meat consumption in France. A study published on 9 October 2015 by the French National Statistics and Economic Studies Institute (INSEE, French acronym), and summarized by Larochette and Sánchez-González (2015) of the INSEE division of Syntheses of goods and services, has led to the following conclusions:

- since 1960, households have devoted a decreasing proportion of their consumption expenses to food purchases: 20% in 2014 compared with 35% in 1960; however, in 50 years, food consumption per inhabitant has steadily increased in volume, but less rapidly than overall consumption;
- the composition of the food basket has changed; the proportion of meat has decreased and reached only 20% in 2014, compared with 26% in 1967 – a record; but meat remained the main expense item in the food basket;
- recurrent food-safety crises since 1996 had an impact on meat consumption, but the consumers moved to other safer meats; for example, during the crisis of the mad-cow disease (bovine spongiform encephalitis, BSE), in 1996, beef consumption fell down (-8% in terms of value and volume per inhabitant), whilst that of horse meat jumped by more than 12% (volume and value), that of poultry increased 6% in terms of value and +3.8% in terms of volume;
- conversely, some purchases are increasingly present in the food basket, such as prepared meals, sugary products as well as soft drinks; since the 1990s, the proportion of eggs and dairy products and fish have remained at standstill.

Also, Angela Bolis (2015) published an article in the French daily newspaper *Le Monde* dated 26 October 2015, where she highlighted the decrease in meat consumption in France, whereas this consumption tended to increase worldwide, especially in emerging countries. She stated that this consumption has been growing by +1.5% per year between 1960 and 1980, and reached a peak in 1998 with 94 kg.ec per inhabitant and per year. Since then, the trend has been reversed: in 2014, the consumption per individual and per year fell down to an average of 86 kg.ec. As mentioned earlier (see the INSEE 2015 study), even though the meat volumes purchased have decreased by 3% in ten years, the money spent during the same period has increased by 17%, because of a 21% rise in the average meat price. The European neighbouring countries have followed a similar trend. Within the 15-Member-States European Union, meat

consumption reached a peak in 2001, with 89.3 kg.ec per inhabitant. In 2013, it fell down to 83.2 kg.ec (including 39.4 kg.ec of pork, 25 kg.ec of poultry, 16.5 kg.ec of beef and 2.2 kg.ec of mutton and lamb). There were some regional differences: the European Northern countries ate more pork, while those of the South, France and the British Islands, ate more lamb and poultry; beef was privileged in Scandinavia, France and the British Islands (Bolis, 2015). At the global level, while rich countries are decreasing their meat consumption, developing countries are consuming more quantities of meat – starting from low levels of consumption. Asia consumes almost half of meat products (46%), China consumes 28% of the global production, ahead of Europe (20%), North America (14%, including 13% for the United States), South America (10%), and Central America, Africa and the Pacific (4%, 5% and 1%, respectively) [Bolis, 2015].

Also in October 2015, a poll carried out by Mediaprism on behalf of the NGO Good Planet and the *Institut national de la consummation – 60 millions de consommateurs* (National Consumption Institute – 60 millions of consumers), has shown that 56% of French people interviewed stated that they ate less meat and 46% among them explained that the price was the main reason for this lesser consumption. According to France Agrimer, the economic crisis has reduced the purchasing power of the customers and forced them to change the content of their food basket – high calorie and cheaper foodstuffs, such as bread, cereals, sugary products; and less meat and fish (Bolis, 2015). However, in 2018, the consumption of beef and veal increased by 2.2% annually, according to the figures given by INTERBEV (the Interprofessionals involved in livestock husbandry and French meat), which evaluates the volumes of meat produced by the national slaughterhouses, withdraws the exports and adds the imports. This calculation gives an idea of bovine meat consumption within households, restaurants and canteens, as well as of the industrial transformation of meat. Such a result may be rather surprising, because the overall trend noticed over the years was towards a general decrease in bovine meat consumption. In fact, when the figures given by Kantar are taken into account, i.e. the amounts of meat purchased in the supermarkets and the quantities of beef and veal sold in the butchers' or in free-service shops, the overall consumption was still decreasing: French people disbursed 3.6% less money in 2018 than in 2017 to buy bovine meat (Girard, 2019c).

On 26 January 2018, Kantar underlined that consumption of meat continued to drop, with ham recently added to the list. While vegetarianism is a trend that is difficult to quantify and only corresponds to 2% of French households (2017), the eating habits of French people are moving towards a flexitarian approach – less consumption of meat proteins – with numbers rising from 25% to 34% in 2016-2017. The French showed a lot of awareness of what they consumed in 2017 and were willing to place value in healthier products such as organic ones (+17% in value); more than half of French people considered the latter as healthy. In the Mediaprism poll, 35% of the interviewed people have mentioned their concern about animal well-being and 26% of them mentioned the food-safety scandals. The CRÉDOC enquiry (see p.139) underlined a trend toward more frugality in the French people's eating habits. However, in addition to the cost, the change in these eating habits is above all the result of lifestyle modifications, according to Gabriel Tavoularis, deputy-director of CRÉDOC's Consumption Department (Bolis, 2015).

The consumption of the beef burger continued to rise in 2018, and the hamburger represented more than half of the beef sold in supermarkets. Such a trend was true at home and outside the households: "In ten years, the quantities of hamburgers in the French restaurants have been multiplied by 14; in 2017, 1.1 billion hamburgers have been sold," according to Bernard Boutboul, director-general of the consultant firm Gira Conseil. In addition to the sales made by McDonald's or Burger King, new specialized brands such as Big Fernand or King Marcel, or their American counterparts like Five Guys, have been present on the market. According to G. Boutboul, "this trend has been buttressed by the restaurants' offer: almost 80% of the 145,000 French restaurants had at least on their bill of fare a hamburger that sometimes has replaced the steak and fried potatoes" (Girard, 2019c).

Eating less meat, and more vegetables and fruit: a major contribution to mitigating environmental degradation

Marco Springmann et al. (2018) published a study where they showed that between 2010 and 2050, as a result of expected changes in population and income levels, the environmental effects of the food system could increase by 50%-90% in the absence of technological changes and dedicated mitigation measures; they would reach levels that are beyond the planetary boundaries that define a safe operating space for humankind. The authors of the study were affiliated to the main following institutions: Oxford Martin Programme on the Future of Food, Oxford Martin School, University of Oxford; Centre on Population Approaches for Non-Communicable Disease Prevention, Nuffield Department of Population Health, University of Oxford; Natural Resources Sciences and Management, University of Minnesota, St. Paul, United States; Environment and Production Technology Division, International Food Policy Research Institute (IFPRI), Washington, D.C.; CSIRO Agriculture and Food, Commonwealth Scientific and Industrial Research Organisation, St Lucia, Brisbane, Australia; Potsdam Institute for Climate Impact Research, Potsdam, Germany; Madrid Polytechnic University, Spain; Environmental Systems Analysis Group, Wageningen, the Netherlands; Hoffmann Centre for Sustainable Resource Economy, Chatham House, London; Beijer Institute of Ecological Economics, The Royal Swedish Academy of Sciences, Stockholm, Sweden; etc.

The food system is a major driver of climate change, land-use modifications, depletion of freshwater resources, and pollution of aquatic and terrestrial ecosystems through excessive nitrogen and phosphorus inputs. World agrifood production has generated the equivalent of 5.2 billion tons of CO_2 in 2010 (i.e. 11 times the total emissions of CO_2 in France). The area of agricultural lands was estimated at 13 million km^2, 1,800 billion cubic meters of surface and underground water have been used, while 104 billion kg of nitrogen and 18 billion kg of phosphorus had to be supplied. A large part of this impact was due to livestock breeding and husbandry – because of the belching of ruminants (mainly methane), and the deforestation caused by the encroachment of ranching and agriculture (Garric, 2018).

The authors of the study – *ca*. 20 researchers from American, European, Australian and Lebanese institutions – have analyzed several options for reducing the environmental effects of the food system, including dietary changes towards healthier, more plant-

based diets, improvements in technologies and management, and reduction in food loss and waste. For instance, they have recommended the adoption of a flexitarian diet, which aims to reduce the intake of animal proteins and to increase that of plant proteins. That meant at the global level an 80% reduction in beef consumption by 2050 – and even a 90% reduction in the industrialized countries –, an 88% reduction in pork consumption, 70% for lamb and 50% for poultry. Milk and eggs consumption should also be reduced by 52% and 27% respectively. They also recommended a decrease in the consumption of palm oil, sugar (-58%) and even of some cereals (rice, -45%, maize, -38% and wheat, -31%). Conversely, the study recommended a rise in the consumption of legumes (+114%), soybeans (+302%), nuts and seeds (+237%) and of plant-derived oils excluding palm oil (+85%). Surprisingly, the authors of the study recommended the consumption of more fish (+60%) and crustaceans (+18%), mainly produced through aquaculture, in order to reach a good nutritional balance (Springmann et al., 2018).

The authors of the study found that no single measure was enough to keep the impact of agrifood production within all planetary boundaries simultaneously, and that a synergistic combination of measures would be needed to sufficiently mitigate the projected increase in environmental pressures. Such recommendations, if they were followed, would reduce by 56% the emissions of greenhouse-effect gases by 2050 – compared with the prospective assumption foreseen if the present situation is not changed – and by 6% to 22% the other environmental impacts – e.g. overuse of agricultural land and water, pollution and loss of biodiversity. The Paris agreement in 2015 "set the objective of remaining under the 2°C threshold of Earth warming by the end of the century," recalled Springmann et al. (2018). But at the same time, the scientists added that, "in order to achieve this objective (+2°C) and to feed a growing human population in a sustainable way, we should simultaneously set up other actions," like the drastic reduction (by half) in food wastage and the improvement of agricultural practices, such as reaching higher yields, but with less inputs, and the efficient use of water. But it seems most likely that with the present and future emissions of greenhouse-effect gases we are heading towards an increase of 3°C in global warming.

In France, similar recommendations have been made. For instance, the Solagro association that is very much in favour of an ecological transition, has issued the following scenario in 2016: called "Afterres 2050", this model has predicted the trend to be followed if France – with 72 million inhabitants by 2050 – wanted to feed its population, while reducing by 50% the emissions of greenhouse-effect gases in agriculture at that date, compared with the 1990 emissions. That meant in terms of diet: an average of 49 g of meat per day and adult; an increase in the consumption of legumes (lentils, chickpeas, etc.) from 15 g to 41 g per day and adult; and more cereals, vegetables and fruit in the daily meals. In addition, the food wastage should be reduced by more than 30% as well as the overconsumption of animal proteins, sugars, salt and fat (Garric, 2018).

On the same issue, the French Terra Nova Foundation – an independent progressist think tank which aims to produce and disseminate innovative political solutions in

France and Europe – published a study on 23 November 2017 on: "Meat in the bill of fare of food transition: Challenges and opportunities of a nutrition with less meat" (*La viande au menu de la transition alimentaire: enjeux et opportunités d'une alimentation moins carnée*). The foundation recalled that meat consumption, associated with the general rise in income and the progress in agriculture, has soared during the 20th century in the industrialized countries; and it is now rising rapidly in many emerging countries. Such trend has raised several concerns. Many nutritionists and dieticians are now much in favour of a more plant-based diet, while epidemiologists have shown that an overconsumption of meat was linked with health problems and diseases. On the other hand, the multiplication of food-safety scandals has induced serious doubts about the safety of meat products. Environment scientists have, on their side, demonstrated that animal husbandry and livestock breeding significantly contributed to the greenhouse-effect gas emissions and that they needed quantities of resources which were disproportionate with regard to their nutritional input. Furthermore, the disclosure of the deplorable conditions of domestic animals in slaughterhouses has raised a wide-ranging emotion over recent years. Finally, the despair of many livestock breeders regarding their low income and the great difficulties to decently live from their work, has shed light on the defects of the value chains in this sector. The Terra Nova Foundation concluded its study by stating that its objective was not to condemn meat consumption, but to try to find out a new compromise between the French culinary traditions and the science-based health, environmental and economic constraints. For instance, during the 20 years beyond 2020, a daily diet including two-thirds of plant proteins and one-third of animal ones – compared with the reverse proportion in 2018 – would become the average norm. This would mean a 50% decrease in meat and fish consumption (Pech, Hardy, Frioux and Vincent, 2017).

In a different context, protecting cattle in India is popular, but the meat industry wanted protecting too. When the State of Maharashtra banned the slaughter of bulls and bullocks, and the possession of beef, at the beginning of 2015, it was bad news for those, mostly Muslims, who turn to the State's ageing cattle into leather and cheap cuts. But it was not surprising. Maharashtra was led by the Bharatiya Janata Party (BJP), which hoped that the ban will play well with its core Hindu voters. More startling was a declaration on 29 March 2015 by the national government's minister of home affairs: he said that he would try to end cattle slaughter across India. Most of India's Hindu majority are vegetarian, and of the Hindu carnivores, most eschew eating cattle flesh. Yet India's beef industry has flourished, with exports growing tenfold in the past decade (2005-2014). The country has become the second-largest exporter of beef, behind Brazil. The paradox depends on a crucial ambiguity: "beef" in India can refer to the meat of either cattle or buffalo, and India's water buffaloes do not enjoy the sacred status of its cows. Since the government began encouraging farmers to raise and slaughter buffaloes, exports of their meat have boomed. More than 95% of meat exports came from them. On the campaign trail in 2014, the prime minister, Narendra Modi of the BJP, decried this "pink revolution" – named by analogy with the "green revolution" of the 1960s, in which crop yields soared. But during his first six months office, India's meat exports grew by 16%. Talking down Muslim butchers play well with Hindu activists. But Maharashtra's chief minister had clarified that the State's ban will not apply to buffaloes – India's cash cows (*The Economist*, 2015b).

Another controversy on the environmental impact of animal husbandry

By the end of 2019, a statement on the environmental impact of animal husbandly and cattle breeding has been issued by the recently-created French National Agriculture, Food and Environment Research (INRAE, French Acronym) which was the result of a merger between the National Agricultural Research Institute (INRA) and the National Research Institute in Environmental Sciences and Technologies and Agriculture (IRSTEA). That statement raised another controversy on the subject. It was an on-line fact-checking which denounced "false ideas" on animal husbandry and which minimized its impact on the environment. The controversy came from a press release at the end of February 2020 by the Institute's affiliated trade-union SUD Recherche, which underlined "the simplifications, shortcomings and omissions of the fact-checking. On 3 March 2020, the trade union requested the withdrawal of the Institute's statement during a meeting of the INRAE technical committee (Foucart, 2020).

But the INRAE maintained its statement where it was questioning the often-quoted figure of 15,000 liters of water needed to produce 1 kg of beef (that include all the stages of cattle raising and the production of meat from the animal's carcass). Instead of this very high figure, the INRAE put forth the figures of 50 liters of "useful water". In addition, the statement underlined the irrelevance of comparing the contribution of animal husbandry to global warming with that of transport – estimated at 14%, each, of total greenhouse-effect gases. It also questioned the fact that the resources allocated to animal husbandry were competing with human food, because 86% of feedstuffs consumed by domestic animals – such as oilseed-derived meals, leaves and grasses – are not eaten by humans. However, the trade-union SUD-Recherche did insist on the fact that the INRAE minimized the environmental impact of animal husbandry and, for instance, omitted to mention the damage caused by the widespread use of antibiotics and the pollution of water bodies. It pointed out that part of the feedstuffs are derived from maize and soybean crops cultivated for the purpose of animal husbandry. The acreage allocated to these crops – which is partly derived from deforestation – could supply food for human populations (Foucart, 2020).

The INRAE replied that it has often highlighted the benefits of reducing meat and animal-products consumption. It also stated that the trade-union was making a mistake, because the fact to "declare that some slogans are false does not mean an unconditional support for animal husbandry." This kind of reply was probably relating to the assumption made by the trade-union that the INRAE position was not very far from that of cattle breeders and meat producers. Regarding the controversial figure of 50 liters of "used water" needed to produce 1 kg of beef, the INRAE referred to a collective expert study carried out in 2016. This figure was also mentioned by the Interprofessionals involved in livestock husbandry and French meat (INTERBEV, French acronym), that quoted the Livestock Husbandry Institute. In fact, the INRAE had to recognize that there is a wide range of the figures concerning the volumes of water needed for raw-meat production; it was therefore ready to review and rectify this figure of 50 liters (Foucart, 2020).

Two INRAE researchers pointed out during this controversial debate that a very comprehensive study on the environmental impact of food production and consumption had been published by Joseph Poore and Thomas Nemecek (2018). Joseph Poore belongs to the Oxford University Department of Zoology and School of Geography and the Environment, Oxford, United Kingdom, whereas Thomas Nemecek is a member of the Agroecology and Environment Research Division (Agroscope), LCA Research Group, Zurich, Switzerland. Both researchers have consolidated data on the multiple environmental impacts of *ca*. 38,000 farms producing 40 different agricultural goods around the world in a meta-analysis comparing various types of food-production systems. Producers have limits on how far they can reduce impacts. Most strikingly, impacts of the lowest-impact animal products typically exceed those of vegetable substitutes, providing new evidence for the importance of dietary change. With current diets and production practices, feeding 7.6 billion people is degrading terrestrial and aquatic systems, depleting water resources and driving climate change. More than 570 million farms produce in almost all the world's climates and soils, each using different agronomic methods; average farm sizes vary from 0.5 ha in Bangladesh to 3,000 ha in Australia; average mineral fertilizer use ranges from 1kg of nitrogen per ha in Uganda to 300 kg in China; and although four crops provide half of the world's food calories, more than 2 million distinct varieties are recorded in seed vaults. Further, products range from minimally to heavily processed and packaged, with 17 of every 100 kg of food produced transported internationally, increasing to 50 kg for nuts and 56 kg for oils (Poore and Nemecek, 2018).

Poore and Nemecek (2018) indicate that efforts to consolidate the data derived from environmental impact assessments of food production and consumption have covered greenhouse-effect gas emissions only, agriculture only, small numbers of products and predominantly Western European producers. Thus, the researchers present a globally reconciled and methods-logically harmonized database on the variation in food's multiple impacts. Their results show the need for far reaching changes in how food's environmental impacts are managed and communicated. Today's food supply chain creates *ca*. 13,7 billion tons of carton dioxide equivalents (CO_2 eq), 26% of anthropogenic greenhouse-effect gas emissions. A further 2.8 billion tons of CO_2 eq (5%) are caused by non-food agriculture and other drivers of deforestation. Food production creates *ca*. 32% of global terrestrial acidification and *ca*. 78% of eutrophication. These emissions can fundamentally alter the species composition of natural ecosystems, reducing biodiversity and ecological resilience. The farm stage dominates, representing 61% of food's greenhouse-effect gas emissions (81% including deforestation), 79% of acidification and 95% of eutrophication.

Regarding processing, more durable packaging and greater usage of co-products can also reduce foodwaste. For instance, wastage of processed fruit and vegetables is *ca*. 14% lower than that of fresh fruit and vegetables, and wastage of processed fish and seafood is ca.8% lower. For products such as beef, distribution and retail losses contribute 12% to 15% of emissions, whereas the sum of emissions from packaging, transport and retail contributes just 1% to 9%. Here, reducing losses is a clear priority. Though producers are a vital part of the solution, their ability to reduce environmental impacts is limited. These limits can mean that a product has higher impacts than another

nutritionally equivalent product, whatever is its mode of production. In particular, the impacts of animal products can markedly exceed those of vegetable substitutes, to such a degree that meat, aquaculture, eggs and dairy use *ca*. 83% of the world's farmland and contribute 56% to 58% of food's different emissions, despite providing only 37% of our protein and 18% of our calories. Can animal products be produced with sufficiently low impacts to redress this vast imbalance? Or will reducing animal product consumption deliver greater environmental benefits? Poore and Nemecek (2018) found that the impacts of the lowest-impact animal products exceed average impacts of substitute vegetable proteins across greenhouse-effect gas emissions, eutrophication, acidification (excluding nuts) and frequently land use. Although tree crops can temporarily sequester carbon and reduce nutrient leaching, the impact of nuts is dominated by low-yielding cashews and water-, fertilizer-, and pesticide-intensive almonds. Production of nuts doubled between 2000 and 2015, and more work is required to improve their resource-use efficiency. Although aquaculture can have low land requirements, in part by converting by-products into edible protein, the lowest-impact aquaculture systems still exceed emissions of vegetable proteins. This challenges recommendations to expand aquaculture without major innovation in production practices first. Further, though ruminants convert *ca*. 2.7 billion metric tons of grass dry matter, of which 65% grows on land unsuitable for crops, into human-edible protein each year, the environmental impacts of this conversion are immense under any production method practised today.

The differences between animal and vegetable proteins will hold into the future unless major technological changes disproportionately target animal products. First, emissions from feed production typically exceed emissions of vegetable protein farming. This is because feed-to-edible protein conversion ratios are greater than two for most animals; because high usage of low-impact by-products is typically offset by low digestibility and growth; and because additional transport is required to take feed to livestock. Second, Poore and Nemecek (2018) found that deforestation for agriculture is dominated (67%) by feed, particularly soybeans, maize and pasture. Animal product processing, particularly emissions from slaughterhouse effluent, add a further 0.3 to 1.1 kg of CO_2 eq, which is greater than processing emissions for most other products. Last, wastage is high for fresh animal products, which are prone to spoilage.

Today, and probably into the future, dietary change can deliver environmental benefits on a scale not achievable by producers. Moving from current diets to a diet that excludes animal products has transformative potential, reducing food's land use by 3.1 billion hectares (a 76 % reduction), including a 19% reduction in arable land; food's greenhouse-effect gas emissions by 6.6 billion tons of CO_2 eq (a 49% reduction); acidification by 50%; eutrophication by 49%; and scarcity-weighted freshwater withdrawals by 19% for a 2010 reference year. The land no longer required for food production could remove *ca*. 8.1 billion tons of CO_2 from the atmosphere each year over 100 years as natural vegetation re-establishes and soil carbon re-accumulates. For the United States, where per capita meat consumption is three times the global average, dietary change has the potential for a greater effect on food's different emissions, reducing them by 61% to 73% (Poore and Nemecek, 2018). See also Kim et al. (2020).

Processed meat and cancer

The modern American diet consists of generous portions served up on demand. Most primarily, that has meant a diet heavy in red meat and processed meat. The hamburger and the hot dog are as much national symbols as they are menu items. Now this is being called into question by medical doctors, by public-health advocates and by the World Health Organization (WHO). This was not just targeting Americans' well-being in mind, but also that of the entire globe – including country after country to which the United States has eagerly exported its diet. In a sweeping review released on 29 October 2015 in the journal *The Lancet Oncology*, the respected WHO subsidiary, the International Agency (Centre) for Research on Cancer (IARC or ICRC, or CIRC, French acronym) based in Lyon, France, officially identified processed meat as a Group 1 carcinogen, meaning the quality of the evidence firmly links it to cancer. Red meats fare little better, falling into Group 2A – foods or substances that probably cause cancer – a category that includes the toxic pesticide DDT, the chemical weapon mustard gas and the insecticide malathion. Groups 2B, 3 and 4 are foods or substances that are possibly carcinogenic, not yet classifiable as carcinogenic or probably not carcinogenic, respectively (Kluger, 2015).

In October 2015, scientists from ten countries met at the IARC in order to evaluate the carcinogenicity of the consumption of red meat and processed meat. These assessments have been published in the *Lancet Oncology* journal (Bouvard et al., 2015) and in volume 114 of the IARC Monographs. Red meat refers to unprocessed mammalian muscle meat, e.g. beef, veal, pork, lamb, mutton, horse or goat meat, including minced or frozen meat; it is usually consumed cooked. Processed meat refers to meat that has been transformed through salting, curing, fermentation, smoking, or other processes to enhance flavour or improve preservation. Most processed meats contain pork or beef, but might also contain other red meats, poultry, offals (e.g. liver), or meat byproducts such as blood. Red meat contains high biological-value vitamins, iron (both free iron and haem iron), and zinc. The fat content of red meat varies depending on animal species, age, sex, breed and feed, and the cut of the meat. Meat processing such as curing and smoking can result in the formation of carcinogenic chemicals, including N-nitroso-compounds (NOC) and polycyclic aromatic hydrocarbons (PAH). Cooking improves the digestibility and palatability of meat, but can also produce known or suspected carcinogens, including heterocyclic aromatic amines (HAA) and PAH. High-temperature cooking by pan-frying, grilling or barbecuing generally produces the highest amounts of these chemicals. The mean intake of red meat by those who consume it is *ca*. 50-100 g per person per day, with high consumption equaling more than 200 g per person per day.

The IARC Working Group assessed more than 800 epidemiological studies that investigated the association of cancer with the consumption of red meat or processed meat in many countries, from several continents, with diverse ethnicities and diets. For the evaluation, the greatest weight was given to prospective cohort studies done in the general population. High quality population-based case-control studies provided additional evidence. For both designs, the studies judged to be most informative were those that considered red meat and processed meat separately, had quantitative dietary data obtained from validated questionnaires, a large sample size, and controlled for the major potential confounders for the cancer sites concerned.

The largest body of epidemiological data concerned colorectal cancer. Data on the association of red meat consumption with colorectal cancer were available from 14 cohort studies. Data were also available for more than 15 other types of cancer. On the basis of the large amount of the data and the consistent associations of colorectal cancer with consumption of processed meat across studies in different populations, which make chance, bias and confounding unlikely as explanations, a majority of the IARC Working Group concluded that there is sufficient evidence in human beings for the carcinogenicity of the consumption of processed meat. Overall, the IARC Working Group classified consumption of red meat as "probably carcinogenic to humans" (Group 1) on the basis of sufficient evidence for colorectal cancer. Additionally, a positive association with the consumption of processed meat was found for stomach cancer. The IARC Working Group classified consumption of red meat as "probably carcinogenic to humans" (Group 2A). In making this evaluation, the Working Group took into consideration all the relevant data, including the substantial epidemiological data showing a positive association between consumption of red meat and colorectal cancer. Consumption of red meat was also positively associated with pancreatic and with prostate cancer.

"According to most recent estimates – the IARC mentioned – *ca*. 34,000 cancer deaths per year worldwide are attributable to diets high in processed meat." The study estimates a possible 50,000 deaths similarly attributable to red meat. Both of these numbers seem low compared with the 1 million deaths due to tobacco-related cancer. But in the United States, there are *ca*. 2 ½ cases of colorectal cancer per year for everyone death, which means that even if eating meat does not kill you, it could still make you very sick. Some researchers are at least trying to put that troubling fact in a positive light. "One way that I am thinking about this finding is that it actually gives us the opportunity of identifying one of the many important factors that contribute to colorectal cancer and that we can do something about," stated Mariana Stern, a cancer epidemiologist at the University of Southern California, who worked on the IARC study (Kluger, 2015).

The IARC study sparked a round of apocalyptic headlines, including many variations of *hot dogs as bad for you as cigarettes*. Predictably, it also caused a lot of confusion for people who are trying to eat right but are buffeted by health recommendations that seem prone to being overturned years later. Because make no mistake: *we like our meat*. The average American consumes *ca*. 35.5 kg of beef, lamb, veal and pork per year. And what Americans do not eat, they sell overseas, where economic growth has been matched by a demand for red meat. The United States is the world's second-biggest exporter of pork and fourth-biggest of beef. No surprise, therefore, the meat industry was hitting back. According to a statement by the North American Meat Institute (NAMI), a trade association that claimed to represent companies that processed 95% of red meat in the United States, and 70% of turkey products, the new IARC report "defies both common sense and numerous studies showing no correlation between meat and cancer. Scientific evidence shows cancer is a complex disease not caused by single foods".

The IARC is accustomed to attacks regarding the quality of its work. For instance, the announcement by IARC experts that glyphosate, part of Roundup – the world's most

widely used pesticide – can be a "probable carcinogenic" substance, had been heavily criticized by Monsanto, the producer of Roundup. The agrochemical firm referred to the results of the IARC study as "rotten science" and requested Margaret Chan, WHO director-general at that time, to "rectify" that result. Also in 2012, the classification of exhausts of diesel engines as "carcinogenic" met with the strong protests of the motor-car industry. According to the latter, the IARC work and conclusion were based on the evaluations of old diesel engines, and not of the recent ones. Despite these attacks and accusations regarding its alarming announcements, the IARC advices enjoy a very high level of acknowledgement from the scientific community as a whole. Because the evaluation process of this agency was following very strict rules: e.g. diversity of scientific disciplines, involved and held together (toxicology, epidemiology, etc.) during the evaluation work; lack of conflicts of interest among the researchers requested to carry out the evaluation; presence of industry's representatives during the working sessions (Foucart, 2015).

In June 2015, upon the initiative of three renowned epidemiologists – Neil Pearce of the London School of Hygiene and Tropical Medicine, Aaron Blair of the US National Cancer Institute, and Paolo Vineis of the London Imperial College – *ca*. 120 researchers from various disciplines relevant to the identification and hazard evaluation of human carcinogens, concluded that the criticisms of the IARC classification process were unconvincing. The procedures employed by the IARC provided a balanced evaluation and an appropriate indication of the weight of the evidence. Some disagreement by individual scientists to some evaluations is not evidence of process failure. The review process has been modified over time and will undoubtedly be altered in the future to improve the process. This does not mean, however, that the current procedures are flawed. The scientists concluded that the IARC monograph(s) have made, and continue to make, major contributions to the scientific underpinning for societal actions to improve the public's health (Pearce et al., 2015).

Warning about meat-consumption health risks go back a long way, but in recent years they have been piling up. An exhaustive 2007 study by the American Institute for Cancer Research and the World Cancer Research Fund International on Food, Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective, pointed to a troubling link between animal protein and multiple forms of cancer. In 2009, Sinha et al. (2009) of the Nutritional Epidemiology Branch and Biostatistics Branch, the Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health (NIH), Department of Health and Human Services, Rockville, Maryland, and with the funding/support of the Intramural Research Program of the NIH, National Cancer Institute (NCI), published a study on meat intake and mortality. The study population included the National Institutes of Health-AARP (formerly known as the American Association of Retired Persons) Diet and Health study cohort of half a million people aged 50 to 71 years at baseline. Meat intake was estimated from a food frequency questionnaire administered at baseline. The scientists investigated red, white and processed meat intakes as risk factors for total mortality, as well as cause-specific mortality, including cancer and cardiovascular disease (CVD) mortality in a cohort of approximately half a million men and women enrolled in the above-mentioned NIH-AARP study (Sinha et al., 2009).

During ten years of follow-up, there were 47,976 male deaths and 23,276 female deaths. For overall mortality, 11% of deaths in men and 16% of deaths in women could be prevented if people decreased their red meat consumption to the level of first quintile, i.e. 9.8 g/1,000 kcal/day compared with 62.5 g/1,000 kcal/day in the fifth quintile. The impact on CVD mortality was an 11% decrease in men and a 21% decrease in women if the red meat consumption was decreased to the amount consumed by individuals in the first quintile. For women eating processed meat at the first quintile level, the decrease in CVD mortality was approximately 20%. The median processed meat consumption based on men and women in the first quintile was 1.6 g/1,000 kcal/day compared with 22.6 g/1,000 kcal/day in the fifth quintile. The overall conclusion of the World Cancer Research Fund International and the American Institute for Cancer Research was that red-and-processed-meat intakes were associated with modest increases in total mortality, cancer mortality and cardiovascular disease mortality (Sinha et al., 2009).

In 2011, the World Cancer Research Fund and the American Institute for Cancer Research have published a study an Colorectal Cancer (2011 Report), within the Continuous Update Project (CUP) - keeping the science current on Food, Nutrition, Physical Activity and the Prevention of Colorectal Cancer (World Cancer Research Fund, 2011). The study (report) included research papers published until December 2009 for all exposers except for fruit, vegetables, *red and processed meat*, etc., and eight papers published until May/June 2010 were included. A published meta-analysis of highest versus lowest intakes of red and processed meat of 13,407 cases from 33 risk estimates showed a significant increased risk (21% for colorectal cancer). A published dose response meta-analysis of 7,367 cases from 14 studies showed a 28% increased risk per 120 g/day increase in red and processed meat. Overall, the Continuous Update Project (CUP) Panel agreed that the overconsumption of red and processed meat was a convincing cause of colorectal cancer (World Cancer Research Fund, 2011).

Rohrmann et al. (2013) also published a paper on meat consumption and mortality. The 47 co-authors of this publication belonged to research institutions from across Europe and elsewhere, and in particular to the Institute of Social and Preventive Medicine Division of Cancer Epidemiology and Prevention, University of Zurich, Switzerland, and various cancer-epidemiology and prevention departments (Heidelberg, Germany; Aarhus, Denmark; Bilthoven, Netherlands; Villejuif, France; Milan, Italy; Cambridge, United Kingdom; Athens, Greece; Boston, United States; Spain). The aim of the study was to examine the association of red meat, processed meat and poultry consumption with the risk of early death within the European Prospective Investigation into Cancer and Nutrition (EPIC) including more than 500,000 participants from ten European countries and, thus, reflecting a very heterogeneous diet. The researchers estimated that 3.8% of deaths could be prevented if all participants had a processed-meat consumption of less than 20 g/day. Significant associations with processed-meat intake were observed for cardiovascular diseases, cancer and other causes of death. The consumption of poultry was not related to all-cause mortality (Rohrmann et al., 2013).

The theories concerning the explanation of the relationship of cancer risk and the consumption of red and processed meats are the following:

- nitrates or nitrites are contained in a lot of processed meats; they are salts from either synthetic or natural sources that are added to meat to preserve it; nitrates often turn to nitrites in the body, where they can react with amines to form carcinogenic compounds that can *damage DNA*;
- the heme iron, found most abundantly in red meat, transports iron in the body; but rat studies have shown that heme might contribute to cancer, possibly by catalyzing the formation of N-nitroso compounds; for now some studies have shown calcium can buffer against the harmful effects;
- carcinogens can form when meat is fried, roasted or grilled at high temperatures; the meat produces more heterocyclic amines (HCA) and polycyclic aromatic hydrocarbons (PAH) – two compounds that have been shown to cause cancer in animals (Kluger, 2015).

The decrease in red-meat consumption in the United States between 1970 and 2015, with poultry picking up much of the slack, may explain the decline of rates of colorectal cancer going from 59.5 per 100,000 people in 1975 to 38 per 100,000 in 2012. Whether this is indeed a result of reduced red-meat consumption or simply better detection and intervention is not clear. All the same, the estimates are that there will be 96,090 new cases of colon cancer in the United States in 2015 and 39,610 of rectal cancer. The lifetime risk for developing colorectal cancer is just 5% for men and a little lower for women. A hot dog a day would raise that risk by 18% *of the 5%* – topping you at about a 6% overall risk. But that assumes that it is all the red meat you ever eat, and those 1% increments add up fast (Kluger, 2015).

The IARC or ICRC report itself takes pains to put the findings in similar perspective, clearly defining the difference between a hazard and a risk. "An agent is considered a cancer hazard if it is capable of causing cancer under some circumstances," the report states. "Risk measures the probability that cancer will occur, taking into account the level of exposure to the agent." That is a point seized on by the meat producers – and it is a perfectly fair one. "The problem with cancer is that it occurs over a lifetime," stated Ceci Snyder, a registered dietician and a spokeswoman for the Pork Board, an industry-marketing group. Noting that a lot of other variables like blood pressure, obesity and exercise can play key roles in cancer and overall health, she added: "We cannot discount the confounding factors." Dave Warner, a spokesman for the National Pork Producers Council – the lobbying arm of the pork industry – took some comfort from the fact that the findings of the IARC were not unanimous. Seven of the 22 panelists either abstained from voting or openly disagreed with the findings. Still, the report did not require unanimity, and a supermajority of 68% confirmed its conclusions (Kluger, 2015).

Tim Hayward in the *Financial Times* (2015) reacted to the IARC study and conclusions by stating: "The problem is that the information is meaningless to the consumers it is supposed to help. Most of the figures in the report refer to the amount of preserved meat eaten 'daily'. I am already wondering about the kind of person who eats bacon every day. Then I am trying to imagine the kind of person who did not give up bacon where we were told its fat was laden with cholesterol and likely to stop our hearts,

… because its salt content would hasten our deaths by boosting blood pressure, … the same kind of person who ignored the fact that smoked products have long been acknowledged as carcinogens." For all the "hysterical coverage," eating behaviour will not change, according to Tim Hayward, because there does not seem to be a clear message about the direct impact on the individual who is really enjoying his foodstuff (bacon, etc.). The global statistics do not identify, in his view, whether it is the meat that is carcinogenic, the nitrates used in preservation, products of fermentation or smoke or salt. He asked: Is a Spanish Ibérico ham, made purely of organic pork and salt, carcinogenic to the same degree as a supermarket sausage filled with preservatives to eradicate the lethal bacteria that are a risk in intensive rearing? (Hayward, 2015). He even added: "We look at internationally based dietary advice – the sequential demonization of salt, animal fat, eggs, carbohydrates – and see that each warning has been brought into question by countervailing research." Although Tim Hayward's opinion does not seem always substantiated by robust studies like that of IARC, his conclusion may seem wise and perhaps reasonable, when he states: "In spite of findings published by WHO, informed medical opinion says it is perfectly OK to consume bacon in moderation and as a part of a balanced diet" (Hayward, 2015).

The US Food and Drug Administration (US FDA) did not seem terribly exercised by the IARC study, noting that the federal government carries its own such research through the National Toxicology Program. "The NTP Report on Carcinogens has not specifically looked at red meats or processed meats as whole food items," stated the FDA spokeswoman at that time, Megan McSeveney. These substances have not been nominated for review for the next edition of the Report on Carcinogens." The Department of Agriculture released a statement in response to the IARC announcement, "encouraging Americans to lead an overall healthy, active lifestyle and eat a healthy, balanced diet." It was hoped that the IARC study and conclusions would strengthen the case for national nutritional recommendations warning about the overconsumption of red and processed meats. For instance, the United Kingdom recommended that British people who eat 90 g or more of red and processed meats a day cut back to 70 g, which was the current average. America's most recent guidelines did not go so far, recommending no upper limit and advising consumers to stick to lean meats only. The final call will belong to the USDA. Any guidance the department offers will require balancing evolving science against consumers' tastes and a significant share of the United States' economy (Kluger, 2015).

EATING AND DRINKING TRENDS; CULINARY COSMOPOLITISM

Brief history of the "new cuisine"

The death of the renowned French chef, Joël Robuchon, on the 6th of August 2018, just six months after that of another emblematic representative of French gastronomy, Paul Bocuse (Lyon), may be considered as the end of the so-called "new cuisine" (Lilti, 2018). This started in the 1970s and was a culinary revolution, but also a marketing trend. It opened a golden era of gastronomy, with a new generation of chefs, such as Michel Guérard, Pierre Troisgros or Bernard Loiseau, in France. They were admired for their talent and enjoyed a worldwide reputation. But they also became clever managers of their businesses. But, according to the historian Antoine Lilti (2018), their triumph, in particular in the media, could not hide the fact that French gastronomy seemed to lose ground. The best restaurants in the world, the gastronomy analysts say, are now located in New York, Copenhagen or Lima.

It should be recalled that the phrase "new cuisine" was invented by the French gastronomy experts Henri Gault and Christian Millau in 1973, but it was also used in the 18th century. In 1742, a book of recipes bearing the title *The New Cuisine*, was published and it reflected the deep transformation of eating habits that occurred during the French Age of Enlightenment. French gastronomy had already won a strong acknowledgement of its quality across the whole of Europe, due to the splendour of Versailles and the luxurious lifestyle of Louis XIV. During the Regency period, before the reign of Louis XV, French gastronomy soared again. "A chef is a divine mortal", wrote Voltaire, who nevertheless was unhappy about some culinary innovations of the mid-1770s. He reckoned that "his stomach could not withstand the new cuisine," and the debates were already quite controversial and highlighted the relationship between taste and medical recommendations, moral or even political issues (Lilti, 2018). Higher social categories could enjoy the pleasures of gastronomy and hire a chef who looked after their eating and drinking needs as well as their festins. By contrast, the food was not good in the inns and all kinds of public spaces where food and beverages were served. But the striking innovation came with the restaurant. The latter was not born during the French Revolution, as a consequence of the unemployment of cooks who were suddenly deprived of their aristocratic clients, but during the 1760s, as shown by the American historian Rebecca Spang. The main restaurant dish was a warm broth, with restoring virtues; those who were preparing it opened specific spaces to serve it, and thereafter they progressively offered other kinds of meals. This experience proved to be very successful just after the end of the Ancient Régime. And during

the 19th century, the restaurant became part of the social institutions in Paris. It was admired by those visiting the City of Light, who were amazed by the endless lists of meals on the bills of fare; such an innovation became the distinctive feature of the restaurant (Lilti, 2018).

With the restaurant era came the time of chefs. Some of them like Antonin Carême – who invented in 1821 the chef's hat –, then Auguste Escoffier, won a great fame; and their reputation was supported by the newborn gastronomic critical expertise. Grimod de la Reynière, the chief editor of the *Almanach des gourmands* (Almanac of the gourmets), who lived during the Napoleon Consulate and Empire, was followed by Brillat-Savarin and several others, who raised gastronomy to the level of an art. This almost esthetic approach to the sophisticated cuisine introduced a contrast in the perception of the cooks, who felt very close to the craft world. The gap was broadened between a few renowned and inventive chefs, who were admired by the gastronomy experts and their clients, and the large part of the profession whose input was acknowledged much later on (Lilti, 2018).

Thus from the historical perspective, since the end of the 18th century, three wide-ranging events were interconnected: the international recognition and fame of the French gastronomy; the restaurant becoming a social institution and a business; and the surge of a few chefs, considered as stars in their field and the media. And according to Lilti (2018) such a combination reached a peak with the generation of Joël Robuchon and his renowned colleagues. Two of these deserve special mention. Alain Ducasse who at the age of 31 was awarded two stars in the French gastronomic guide Michelin, after having worked in renowned restaurants. Today, he owns the Louis XV-restaurant ubicated in Monaco. In 1994, A. Ducasse has become a world star; some of his well-known and excellent items on his menu are the wild angled sea-bass, the niçoise salad or the soufflé apricots. In 2009, he was already at the helm of an empire, having purchased and revisited many restaurants across the world; he also edits books and opens new hotels. By the end of 2018, A. Ducasse's food and business empire has been completed by the launching of a restaurant on a narrow boat in Paris, called "Ducasse sur Seine", the issuing of an Advent calendar and the opening of a chocolate-making factory in London. A. Ducasse has been pioneering the multiple uses of the black truffle (*Tuber melanosporum*) in French gastronomy. He utterly combines the fame of a great cook and the talents of a very clever manager and businessman (Beaugé, 2018).

The second is Pierre Gagnaire who, with Joël Robuchon and Alain Ducasse, has been among the rare chefs to be awarded several Michelin stars (16 in 2019) and who runs many restaurants across the world. He was born in 1950 in Saint-Etienne (centreeast of France) and, in 2019, he was owning a three-star restaurant in Paris, a large café serving beer and light meals and an Italian restaurant. Elsewhere, across the world, he has signed contracts aiming at being responsible for designing the meals, in places ranging from a large café serving beer and light meals in Las Vegas to the very sophisticated and gastronomic restaurant the Sketch, in London. The latter was awarded three Michelin stars at the beginning of October 2019. It was opened in 2003 and it is part of a building including a hotel and high-end gastronomy restaurant,

three cafés, as well as an amazing offer of cocktails and clubbing, amidst a modern-art architecture and decoration (Von Bardeleben, 2019b).

But how Pierre Gagnaire can manage 23 gastronomy spaces and brand names at the same time? Elvire Von Bardeleben, a journalist at the French daily newspaper *Le Monde*, tried to find out and she published as article on 29 November 2019, titled *A la manière de Pierre Gagnaire* (Pierre Gagnaire's Style). She mentions that in the case of the Sketch, in London, he selects himself the varieties of tea to be served at tea-time to ca. 200 clients per day – this period of the day is a pillar for the Sketch's turnover or revenue. He also has been thinking for several hours about the winter menu of 2019, then he dictates it to his assistant, while keeping the list in his copy-book. Thereafter, the menu will be sent to all his collaborators who will implement it. He has his ideas, sometimes controversial, about combining many flavours or savours in the same meal, while other chefs advise to put in the same dish no more than three.

According to E. Von Bardeleben (2019b) he explains his art frankly and simply and he gives details about the contracts he signed overseas in order to finance his three-star Paris restaurant, whose funding situation is always frail – he has been recently facing three floodings and the strikes in Paris could have a heavy impact on the attendance of the restaurant. To the question: what do the Michelin stars represent? He emotionally answered "After having to start working early, after having been humiliated and after the failure of a project he started in Saint-Etienne, yes it is good to be recognized for one's achievements." He is kind with his assistants, he supports them, encourages them and puts them at the forefront, he also requests news about their family. And he likes to transfer the basic pillars of his cuisine to the young generations (Von Bardeleben, 2019b).

When the chef is in front of his staff, just before starting the service, there seems to be some tension in the air, because he makes his comments and critics on the meals being prepared, while at the same time he congratulates his staff. *Le Monde* journalist who was present, tried to create a distraction by asking Pierre Gagnaire: "Is there any fun in your work?" He bluntly replied: "I am not having fun, I am working consciously, I cannot stop, I have not the means to do it!" He explained that he has devoted his life to his work, sometimes neglecting his family, but not to the extent of being a "bastard". This sincere and fiery reply had the merit to make people around him to relax. What is amazing in the meals prepared by Pierre Gagnaire is that each mouthful is followed by a stunning surprise: what was expected, collapses. For instance, "the braised turnip served with *miso* has a splendid sweetness when it is eaten with plump gnocchi. But the following mouthful, when chewing a green olive, makes the dish more salty and sour, until the teeth crunch a dried and sweet apricot, just like an Oriental caresse. The following dish looks like a vegetarian couscous with its spiced broth, but a closer look shows that it contains in addition to the vegetables Morteau sausages and oysters (Morteau sausage is a smoked sausage from the east of France – Franche-Comté region). Regarding the foie gras fried on baby onions and served with mango cubes, pear jelly and passion fruit, it is the climax for the taste buds, which are destabilized by the sequence of freshness, candiness, fat and acidity" (Von Bardeleben, 2019b).

In 2019, Pierre Gagnaire has published a book titled *Les copains d'abord. 80 recettes faciles et conviviales* (First The Friends. 80 Easy And Convivial Recipes, Solar ed., 248p.) where he compiled recipes adapted to merry gatherings, with one whole chapter devoted to meals served on the eve of Christmas and that of the new year. The book contains recipes inspired from rural areas, mountains, the sea or urban life, which are all refreshingly imaginative. For instance, one could quote some mouthwatering ones: scallops cooked in ale beer, Paris-mushroom cream with sweet curry and the soufflé rhubarb-and-apple pancakes (Von Bardeleben, 2019b).

The Gault & Millau gastronomic guide

The French gastronomic guide Gault & Millau has been published in 1972 by Christian Millau and Henri Gault. It is considered a competitor of the renowned Michelin guide, which awards its stars to distinguish chefs and restaurants. Gault & Millau showed, right from the outset, a strong antagonism against gentry cuisine; it used to track the meals containing too much butter, too much cream, in other words the meals that are considered too heavy as well as the sauces that are far from being light. At the beginning of the guide, a team of epicureans and non-conformists used to travel across France, and, for instance, express their great satisfaction when eating a salad of green beans made by Paul Bocuse (Lyon) or frogs' legs cooked with herbs by the Troigros Brothers in Roanne. That was the beginning of a new cuisine. H. Gault and C. Millau even published guidelines for the renowned chefs that suggested to avoid cooking the meals for a long time, to make the menu lighter and to innovate. Gault & Millau largely contributed to the discovery of new and great chefs in France. Since 2011, the guide has been purchased by Côme de Chérisey; in 2019, a Russian investor became the owner of the guide. However Jacques Bally, a Frenchman associated with Gault & Millau in Russia, acquired a minority participation in the enterprise's equity. J. Bailly indicated that the enterprise had, among its priorities, the dissemination of the French culinary heritage. In this respect, education is a top priority and activities are carried out through 35,000 schools across the world. The guide also wanted to extend its ranking (concerning chefs and restaurants) to the whole food world – e.g. creating a Gault & Millau label for culinary products. Finally, the aim of the enterprise was to digitalize all the data collected on these culinary traditions and innovations. Further to the implementation of this strategy, J. Bailly hoped to multiply by five the annual turnover of Gault & Millau (Vulser, 2019).

Culinary cosmopolitism

Culinary cosmopolitism, i.e. mixing in the same meal African, Asian and French cuisine, once considered foolish, is coming back on the tables of nowadays French restaurants and of Paris' renowned ones. While the presence of *sushis* on a menu generally indicates a Japanese influence, how about suggesting on the same à la carte menu "crispy *sushis* with citrus fruit and *chipotle*", or proposing asparagus from the Loire Valley in a *miso* broth and pancake filled with crab meat flavoured with a Madras curry? This is part of the menu designed by the French chef Cyril Lignac in his restaurant at Saint-Germain-des-Prés, in the Latin Quarter of Paris. C. Lignac, a renowned chef, regularly elected as the "preferred chef of French people," has more

than 800,000 subscribers on his Instagram web site; he was not the only one who has tried and launched the fusion cuisine. In June 2018, one of the most respected French chefs, Yannick Alléno opened in a very traditional restaurant, Pavillon Ledoyen, founded in 1779, a new brand called L'Abysse. Awarded a Michelin star, L'Abysse is a temple of fusion cuisine: *sushi* with black truffle, chaource (French soft cheese) iced with Japanese whisky, chocolate with *yuzu* – a Japanese lemon species – and biscuit with algae. He explained that "he was incorporating strokes of French cuisine into the Japanese one, that can be very mellow" (Von Bardeleben, 2019a).

"Fusion is a deliberate approach of a cook who is very conscious that he is blending two cultures," stated Bénédict Beaugé, who authored many books devoted to the cultural changes in cuisine. Fusion made its first appearance in the 1970s in two regions of the world where exchanges occurred between populations: the United States and Australia. "That fusion was a product of the 1970s is not surprising, because that was an era where one could think that everything was possible, everything should be tried and one should get rid of old principles, once for all," he added. In France, the first attempts of fusion cuisine were made at that time, when the French chefs Alain Senderens and Michel Guérard, returning from a trip to China, decided to garnish ravioli with lobster (A. Senderens) or with foie gras (M. Guérard). In the 1980s, Jean-Georges Vongerichten, a French chef settled at the Mandarin Oriental hotel in Bangkok, became one of the heralds of fusion cuisine. "At the beginning, it was an issue of necessity: I was using the products locally available. As I had no apples to accompany the foie gras, I used mango. Nowadays, it is different: the world populations have mixed and the cuisine followed suit," he explained (Von Bardeleben, 2019a).

In the 1990s, in the big cities of the Anglo-Saxon world, the cooks used mixtures of different cuisines, like in London, where the "new British food" movement bridged Indian and British cuisines. This trend was naturally rooted in the melting pot occurring in England and the United States. In France, the story was distinct: on the one hand, there are those who stick to tradition, and on the other there are those who want to imitate what was happening in London and New York. The latter "started to play with food in a rather superficial way," stated Alexandre Cammas, a co-founder of Fooding. "That was the period of *nems* cooked with chocolate at the Café Mosaic of Paul Pairet, and of chicken flavoured with coca at Korova, the restaurant of Jean-Luc Delarue – a total failure with a colossal debt and closing down two years after its opening –", he stated. "During the 1990s, those chefs who adopted the fusion cuisine did not have any idea of what they were doing, except that they were proposing a trendy cuisine," stated abruptly the gastronomic writer Bénédict Beaugé (Von Bardeleben, 2019a).

At the beginning of the year 2000, while France became aware of the very superficial aspect of its fusion cuisine, the locavore movement emerged as a reaction to that situation. Chefs such as Yves Camdeborde, relaunched the bistro cuisine and made it a fashionable trend, relying on simple products, locally produced and at the right season; no showing off. The terroir is put in the pan, and some chefs even boasted they were not using olive oil, considered too exotic. But in 2019, fusion cuisine came back; not across the whole country, but in renowned restaurants (Lignac), awarded with Michelin stars (Alléno), or playing the role of precursors; that was the sign of its

future boom. This return could be explained by the fact that French people were tired of the likelihood to feed themselves with Jerusalem artichokes, butternuts and turnips, grown locally. But there are more profound reasons. The most obvious one is that the cooks were traveling a lot: e.g. some of them opened a second restaurant in London, others accepted a residence in Hong Kong, organized a dinner party with a Colombian partner in Bogotá, or participated in the ceremony of ranking the 50 Best Restaurants in the world in Singapore. After each journey they brought back new ideas and distinct food ingredients; that approach was obviously adopted by those who traveled a lot and were more opened to novelty than ten or twenty years earlier (Von Bardeleben, 2019a).

Among the Paris restaurants which serve this fusion cuisine most frequently, one may quote Le Rigmarole, with at its head Jess Yang, an American-Taiwanese, and her French-American companion, Robert Compagnon, who learnt cooking in the United States, in a *yakitori* kitchen. Their cuisine made over embers and containing French, Japanese, Italian, American and Indian components and flavours, is almost impossible to classify, but it is "delicious" – this adjective suits it undoubtedly. In Paris, there is also a generation of young and talented chefs who have been working since 2004 to update the Asian cuisine and make it trendy. Among those chefs, one may quote the Japanese Taku Sekine, who opened the restaurant Dersou in 2014. He stated: "When I see products, I only want to transform them into a wonderful meal, and to that end I may cook them with butter or in a *dashi* broth. I have no limitations." Tatiana Levha, whose mother is Filipino, is the chef of the restaurant Servan, where she prepares a wonderful blood sausage with chilli; she uses French products and techniques, but her fusion approach relies on condiments and sauces. "Since these young chefs have given its respectability to foreign cuisine, more people attend their restaurants where one can eat with sticks or one's fingers, and where meals are spicy. People like the unamenable-to-discipline side of a restaurant like CAM, where one might feel like in Brooklyn or in a backroom!", explained Nicolas Chatenier. And in fact the restaurant of the Korean chef Eseu Lee, in the Arts-et-Métiers district of Paris, is always full up (Von Bardeleben, 2019a).

Are French people fed up with French gastronomy and of the lengthy meals of the star-spangled restaurants? "In the short term, we shall probably close the gastronomic restaurant (three stars on the Michelin) at lunch time," stated Yannick Alléno." For a lunch, prices are too high and it takes too much time. "Although the French chef emphasized his attachment to all kinds of decorating the table (cloth, chinaware, sauces), he admits that "his clients are very happy to eat *sushis* with their fingers." Such a statement is particularly surprising, because this chef would have been unable to open a fusion restaurant a few years ago, because he felt that "the customers would not have been ready." Regarding Cyril Lignac who was very much inspired by Londonian restaurants in order to renovate his own kitchen in Paris, he stated: "Nowadays, if in my bistro I prepare only French cuisine, I might be bored. The customers want to be surprised and to make culinary discoveries." "Chilli, spices and herbs do not help to get tired after the first piece in the mouth," explained Jean-Georges Vongerichten, the French emblematic chef of fusion cuisine settled in New York. One may therefore ask the following question: in a multicultural world where changes are occurring more rapidly and where the digital revolution is increasingly interconnecting people, is it really meaningful to tie a cuisine to a particular country? (Von Bardeleben, 2019a).

Contemporary Asian-American cuisine

In the United States, the wave of contemporary Asian-American cuisine started to move in the early 2000s from New York to California. This denomination was given by the I magazine of *The New York Times* and it owes a lot to the renowned Korean American David Chang, who created in 2004 the Momofuku restaurant and started to sell his pork *bun* – a small sandwich filled with streaky bacon in steamed bread, complemented with an Asian barbecue sauce (*hoisin* sauce) and sweet-and-sour gherkins. According to the Japanese chef Taku Sekine, "David Chang gave a basic education to the consumers and was an example for his peers." Through the media, D. Chang has been able to show that with some know-how and a sense of provocation, it is possible to update old cooking traditions coming from the other end of the world (Labro, 2018d).

It is true that in the United States as well as in Europe and other countries tastes and meals from the Far East are now present or available everywhere: in slow, fast and street food, or in sophisticated restaurants. This wave has a history in every country, sometimes quite old or recent, due to the migrations and outstanding growth rate of tourism. Street food deserves a special mention, because it is derived from the richness of Asian cuisines, made available in the streets of Bangkok, Tokyo, Singapore, Taipei, Seoul, Manila, Shanghai or Saigon (Ho Chi Minh City). The small-sized meals served to the consumers are very appetizing, incredibly creative and varied – often much more than in conventional restaurants. These meals can be eaten at any time and they are often shared in a cheerful atmosphere. Each stand or carriage has a special meal such as omelettes, doughnuts, meatballs, soups, pancakes or kebabs. See pp. 107-110.

Michael Chow, 80-years old in 2019, the glamour of the Asian-American cuisine, is a star in the United States: in New York as well as in Los Angeles, this Chinese emigrant has made his restaurants not only gastronomic encounters but also meeting places for all kinds of artists and members of society circles. He is the chef who made Chinese cuisine part of American society, at the right place and the right time. He was also part of the cultural life of the 1960s and even appeared in a dozen pictures. The world's most famous artists have painted his portrait or photographed him. In 2018, he celebrated the 50th anniversary of his chain of Chinese restaurants, with the attendance of many VIPs. His father, Zhou Xinfang, a star of Peking Opera, told him: "Wherever you go, always remember that you are Chinese"! He was at that time 13 and embarked on a liner bound to the United Kingdom. His mother, a heir of a Chinese-Scottish family involved in the tea business, supported him for five years. That was in 1952, when Zhou Yinghua, after a golden childhood in Shanghai, not speaking a single word of English, became a teenager in an austere British board school. Now christened Michael Chow, he studied arts and architecture at the Central Saint Martins School, while in China Mao Zedong launched the Cultural Revolution. His parents were the victims of this brutal revolution; they were persecuted, their books and paintings were burnt; his mother was forced to sweep the streets and his father was put in jail. Michael Chow never saw them again (Chayet, 2018).

After his arts studies Michael Chow started a career of painter in London, while at the same time, in 1966, he opened a fashionable hairdressing parlour. Thereafter, he sold it and in February 1968, he opened a Chinese restaurant; Mr Chow, with a pop name – in English-American slang "chow" means food – and amidst a vibrant cultural life, he greeted the Rolling Stones at the inauguration of his restaurant, of which walls were progressively covered with paintings signed by Jim Dine or David Hockney. Michael Chow abandoned for a while his paintings and enjoyed a luxurious lifestyle, marrying a young superb model, Grace Coddington, for a brief period. The model was to become the design director of the fashion magazine *Vogue*. At that time, during the late 1960s, China was far from being appreciated in the West; Chinese migrants in the Western countries seemed to be almost condemned to manage launderettes or cheap canteens. Chinese cuisine was despised. But Michael Chow wanted to change all that. In his restaurant, clients used silver cutlery and not sticks, and were surrounded by numerous waiters speaking English with an Italian or French accent. M. Chow was a great admirer of the Paris restaurant La Coupole; he selected the softest napkins and the heaviest ice buckets – those used on the French liner, Normandie. His one-page menu was closer to the Peking cuisine than the Cantonese one, because "this is the noblest cuisine, the imperial cuisine," it includes, for instance, stretched noodles and Peking duck. The portions were deliberately small and the prices extremely high (Chayet, 2018).

In 1974, he opened a restaurant in Los Angeles and in 1979 another one in New York, on 57th Street, where he attracted Andy Warhol and his clique. In Manhattan, he set up his Art Deco pieces of furniture and lived with his second wife, Tina Chow, just on the top of the restaurant; each evening the couple went down to welcome their clients amidst white roses, white lilies and orchids. "It was this presence and hospitality that made Mr Chow a preferred meeting place of artists," stated the art-gallery owner Jeffrey Deitch. The latter dined in the restaurant for the first time in 1984, invited by Mary Boone who sponsored the first exhibition of the French painter Jean-Michel Basquiat. This painter was to become a renowned one, but he died rather young – in 2018-2019 an exhibition was devoted to him as well as to Egon Schiele at the Foundation Louis-Vuitton in Paris (Chayet, 2018).

M. Chow's philosophy was that "most restaurants were managed like banks, but I decided to manage mine like music-halls" … "The primary motivation is to entertain people." In a way, by saying so, he wanted to be like his father, a great dramatic actor – this was nevertheless quite impossible because he suffered from asthma. In the mid-1980s, after traveling back to China for the first time since he left the country, he sank into a serious depression. Tina Chow, the mother of his two children, died from AIDS in 1992 at the age of 41. "But the show must go on …". In 2006, he opened his second restaurant in New York, in the Tribeca district, but the critics did not welcome the event and wanted in fact to sink it. In *The New York Times*, Frank Bruni wrote that some meals were "unforgettable", e.g. the knuckle of lamb "seemed to have been in a freezer for a dozen of years and then heated in a microwave oven for a long part of the day." The *New Yorker*, the weakly newspaper of the intelligentsia, went even farther, writing that this was "dung on a silver tray." Michael Chow was obviously very upset, but he carried on … During the same year, the American edition of *Vogue*, another

jewel of the Condé Nast press group, devoted ten pages to describe the magnificent Californian house where he was living with his third wife and their daughter Asia. His restaurants were always full up. In February 2018. On M. Chow's 50th anniversary, *The New York Times* wrote about this "stainless brand" which has withstood the test of time: "Mr Chow keeps its glory, even though its clients were repeatedly told they were crazy to pay so much for sautéed noodles" (Chayet, 2018).

At the beginning of the 2010s, Michael Chow went back to art and he delegated the daily management of his seven restaurants. It was his friend Jeffrey Deitch, director of the Los Angeles Museum of Contemporary Art, who encouraged him to paint again, when he was then 70. Consisting of half paintings and half sculptures, his artwork has been exhibited in Peking and thereafter in Shanghai, next to the impressive collection of his portraits made by J.M. Basquiat, A. Warhol, Ed Ruscha, Francesco Clemente, Dan Flavin and others, and also next to a tribute paid to his father – now rehabilitated. M. Chow stated that "the Americans still see me as a chef and restaurant owner, but the Chinese people appreciate me as an artist" (Chayet, 2018). He still deserves the great merit of being among the pioneers of the Asian-American cuisine, and especially of the Chinese one.

Far-East cooking in France

Origins

Coming from the region of Wenzhou, in the south of China, the first Chinese migrants arrived in Paris by the end of the 19th century, almost at the time of the Universal Exhibition of 1889. They were pedlars, but also craftsmen and specialized workers – in embroidery and lace, leatherwork or jewellery. These Chinese families settled near the Lyon Station (centresouth of Paris), in the so-called *îlot Chalon* (Chalon islet). Small restaurants were opened to feed the families with the scarcely available food ingredients. On 8 March 1914, a few months before the beginning of the First World War, the novelist and gastronomic analyst Francis de Miomandre published in the daily newspaper *Le Figaro* an article praising this nascent cuisine. He mentions these unusual ingredients which mesmerized him: dried fish, lotus seeds, soybeans, bamboo shoots, "fresh litchis that have a rose flavour". But also rice which is eaten instead of bread, the sauces, the slicing of meat into "very thin and long pieces" (Labro, 2018c). During the First World War, France recruited more than 100,000 workers from China in order to replace the manpower that had to go to war. Thereafter, a few thousands of these workers remained in France and joined the first incoming migrants. During the 1960s, the Chinese community moved towards the north of the city – Belleville and thereafter to the Seine-Saint-Denis department (Labro, 2018c).

First wave of Chinese restaurants

Between the First and Second World Wars, *ca*. 40 Chinese restaurants were opened in Paris, especially in the Latin Quarter. The food served there was above all "a cheap and nourishing daily cuisine," stated William Chan Tat Chuen, an expert in Chinese civilization and in food crops. "This cuisine mainly aimed to meet the food needs

of Chinese expatriate students as well as of a few clients who traveled to, or lived in, Asia," he added. The food sector – restaurants and small businesses – became the main activity of the Chinese population living in Paris. But slowly there was a diversification of the Chinese cuisines: the Cantonese cuisine (sweet and salted, spicy), that of Shanghai or Jiangsu (sophisticated and sensuous), that of Sichuan (perfumed and very spicy), Peking or Shandong (with ingredients from the land and the sea). The restaurants themselves changed: from the community inns to rare gastronomic places, and through popular restaurants which tended to meet the tastes of Western people and, for instance, proposing a menu including just a starter, a main course and dessert; this was unthinkable in China, where all meals are shared during the same lunch or dinner (Labro, 2018c).

"The present offer of Asian cuisine in Paris can be understood through the analysis of the different Chinese migrations, and in particular its distribution by "regions", explains the gastronomic newsman (Manu Mariani), who works for Mandarin TV channel. When China, after the victory of communism, locked its borders in 1949, the Chinese migrants came from the region of Chaozhou, as well as from the neighbouring countries' Chinese diaspora. They mainly settled in the 13th district of Paris and, there, appeared the first pluriethnic restaurants. During the 1970s and 1980s, this blending of cuisine cultures reached another dimension with the massive arrival of refugees (e.g. boat-people) that fled from South-East Asia because of political repression: Laotians, Vietnamese, Cambodians, and also persecuted Chinese communities. By the end of the 1980s, on the long menus of the canteens which mushroomed in the Choisy triangle – between Choisy and Ivry avenues and Massena boulevard –, as well as of the increasingly numerous "Asian caterers" one could notice a blending of culinary recipes, which brought in some uniformization of savours and flavours (Labro, 2018c).

French-Asian fusion cuisine

There are many renowned chefs, like Thierry Marx, who praise, or are fascinated by, the Asian cuisine. For instance, Alain Ducasse, Michel Troisgros, Pierre Gagnaire, Pascal Barbot have always borrowed something from the Asian cuisine, e.g. using condiments, spices, chillies, herbs, algae, sauces and broths. Some of them have based their brand on it, such as William Ledeuil at the Ze Kitchen Galerie or Adeline Grattard at her Yam'Tcha, who include in their gastronomic creations a lot of Asian flavours. These two restaurants that were awarded a star by the French gastronomic guide Michelin are typical examples of a real fusion cuisine. On the same wane, at the renowned restaurant Pavillon Ledoyen, near the Champs-Elysées avenue, Yannick Alléno opened a *sushi* bar, while Cyril Lignac in a restaurant ubicated in the Latin Quarter, Le Bar-des-prés, served carpaccios of *wagyu* beef with *ponzu* sauce and truffle or coated-with-caramel scallops and *miso*. It is from this Japanese bovine breed, *Wa* (Japan) *gyu* (beef or ox), that Kobe beef is prepared; it has a melting and marbled flesh, and is the top of gastronomic sophistication (Labro, 2018c).

One could add the mouthwatering (*phô*) soups served at lunch, every day, at the Dauphin, the second address of the "bistronomy" pioneer, Inaki Aizpitarte. Or the innovative and delicate fusion meals made by the cosy restaurant or bistro from Lyon,

La Bijouterie, that the gentry of Lyon attends to taste its bold preparations. Also the restaurant Elements, winner of *Fooding* guide – best table in 2018 – located in Bidart, in the Basque country; the chef-globe-trotter Anthony Orjollet has created a disruptive cuisine, with the best products of the neighbourhood and incredible inspirations from abroad, e.g. lacto-fermented curcuma, soya *tempeh* made in the French Landes region, *kimchi* made using the Espellette red pepper. All these examples may lead to think that the "Asian touch" explains, to a significant extent, the success of the French contemporary eating addresses (Labro, 2018c).

The chefs involved in this fusion trend are scions of the second generation of former migrants, who were born and educated in France, but whose tastes have been influenced by their ancestors' recipes. This is the case of Nicolas, Frédéric and Alexandre Souk, the three brothers who purchased Lao Siam, the restaurant founded by their parents in Belleville (north of Paris) in 1985. Coming from the Mekong region, at the border between Laos and Thailand, the family has prepared a menu rooted in different cultures: banana-flower salad, crying tiger, grilled rice with beef… Progressively, the three brothers were trying to clean up the dust and renovate their heritage. "We have reduced the list on the menu and chosen sustainable fishing, homegrown products and added organic wines … because we like this approach," they stated. Also not very far from Belleville, Double Dragon, the restaurant of Tatiana and Katia Levha – who had already established a solid reputation thanks to their restaurant Le Servan, opened in 2014 in the 11th district of Paris – is serving zakouskis, cockles spiced with Thai basil and other spiced meals. Their signature was highlighting rather hot meals, herbaceous, acid and lively. With Double Dragon, the two French-Filipino sisters who grew up between Manila, Bangkok, Hong Kong and Paris, stated that they made their dream a reality: "We wanted, since a long time, to create an Asian restaurant where one can eat rice, spiced meals and fried food. Because that was what we have been eating since our childhood." And all the Asian biomarkers are present in terms of textures and tastes: sauces, salted taste and *umami* (taste enhancer), absence of dairy products – with the exception of *tofu* stuffed with French Comté cheese –, the slippery of noodles, the crispy fried foodstuffs, the broths, herbs – the fresh and the spicy. The overall result is both strong and sophisticated and the public is largely satisfied and comes back again. Julien Pham concluded: "We have reached a moment when the French techniques meet with Asian influences, and that may give rise to something wonderful" (Labro, 2018c).

Another definition of the Asian cuisine was given by the Japanese chef Taku Sekine, who runs the restaurant Dersou in the 12th district of Paris: "What defines it, it is not the products or the geography or the history, it is above all a feeling. Deep savours and textures which upheave the mouth and the body." He also took over the famous Chinese restaurant in the 19th district of Paris, Le Cheval d'Or (The Golden Horse), and transformed it into an Asian bistro serving sakés and organic wines. He insists on the fact that "Asian cuisine, be it gastronomic or of a bistro type, modern or traditional, is above all very cooked" (in the sense of sophisticated). It includes quick cooking procedures and minimal setting of the table, but "it always needs many long preparations upstream." Esu Lee, the Korean chef who operates at the CAM (see p. 194), started working at 8 o'clock in the morning – while he opens only at night – in order to

prepare its marinated meals, fermented food, or hot-pepper paste; he stated: "One can find extraordinary products in France, like meats, fish, vegetables, as nowhere else, but with respect to sauces and condiments, it is more complicated, and therefore I make them myself". Esu Lee, who spent some time in Sydney and Hong Kong, as well as Taku Sekine, Tatiana Levha or Céline Pham, cannot work without having access to excellent, traceable products, available in season and homegrown to the largest extent possible. That was not unfortunately the case in former conventional Asian restaurants. But today, shorter menus, free inspiration and multiculturalism are, with the search for higher-quality products, the pillars of this new cuisine looking towards the East, and the future (Labro, 2018c).

Present situation

It is true that today Far-East cuisine and tastes are present in all the streets and tables of France. The French sandwich made of a slice of ham in buttered bread may be replaced by the *bánh mi* and the *bao* burgers. Increasingly, people can have a quick lunch and generally less expensive than anywhere else with a *bo bun* or a plate of *sushis*, instead of selecting a lunch formula in a large café serving light meals. Chinese cuisine has a wide range of meals and its costs are reasonable, or even cheap – with the exception of sophisticated Japanese restaurants and a few Chinese ones in luxury hotels. In Paris above all, but also in Lyon, Lille or Bordeaux, culinary offer seems to be endless. The *Fooding* guide called this period the "hipster-Asia". The caterers that delivered a generally bad food have been replaced by new good-looking restaurants often offering one single product: e.g. steamed raviolis, *bibimbap* or noodles garnished with *umami* (the fifth savour which makes your mouth watering) but without glutamate – a well-known taste enhancer (Labro, 2018c).

In the streets of Paris, there is an increasing number of restaurants or small shops that offer such typical meals as broths, fried raviolis and sautéed noodles. The inhabitants of the French capital who became fond of spicy meals, used to attend such places as Grand Bol, in Belleville, or La Taverne de Zhao, in the 10th district, or the Sichuan Canteen – with a wide range of food, from spicy to very hot – in the 3rd district and near the Bastille square. Let us take the example of a few Chinese restaurants also located in Paris and that are not expensive, but sill serve good and tasteful food. Near the metro (Tube) station Arts-et-Métiers (Arts and Crafts), in the centre of the town, at the restaurant called CAM, gastronomic experts have been fascinated by the attendance of cosmopolitan clients – as if we were in Brooklyn – who could simply and stunningly eat such meals as: a vegan *tempeh sashimi*, marinated vegetables with *shiso-soya* sauce and *nori* algae; or, what the gastronomic experts in attendance called a concentrated summary – in a few mouthfuls – of a new-generation Asian cuisine; the latter had of course its traditional roots, but it is also creative and authentic, and above all amazingly mouthwatering (Labro, 2018c).

Let us move to the 9th district (centrenorth of Paris), Marie Aline (2018b) has discovered a small restaurant called Nouilles Ceintures where one can have lunch for €10. The owner who likes to talk with the clients, tells you that she owned thirteen Japanese and Chinese restaurants, but she sold all of them with a view to building up something

close to his regional cuisine. Spices are imported from Xi'an to be used in broths. The bill of fare very well suits those workaholics who have little time for lunch. One can choose among a range of pasta, all handmade with wheat flour and also eggs for the threadlike ones. A recommended option is to choose the XL ones which are 5-cm wide and 40-cm long, garnished with pork (cooked for a long time), Chinese cabbage, chilli, garlic, coriander and chives. With respect to chilli, one may choose between three grades, from 0 to 3. "Chinese cabbage" means in fact plants belonging to the Cruciferous family and to the species *Brassica rapa* (*pak-choï*) and *pekinensis* (*pé-tsaï*). They have been introduced in Europe one century ago; they are sweet, low-calorie and very easy to digest. But they differ in their uses, aspects and tastes. The *pak-choï* has a chalyx shape, ribs similar to those of the Swiss chard, oval and deep-green thick leaves, while the *pé-tsaï* has the shape of a shell, with big, and pale-green or pale-yellow soft leaves. Both subspecies are from China – the first one from the north and the second from the south of the country; they are cultivated and appreciated throughout Asia. The *pak-choï* is often cooked, sautéed in a wok or added to a broth. The *pé-tsaï* can be eaten raw, cooked or fermented, in a stew or with meatballs. In Korea, more than 90% of Chinese cabbage is fermented to make the *kimchi* – a national meal which tastes like a very hot sauerkraut (Labro, 2018d).

Marie Aline (2018b) mentioned that in the low-cost Chinese restaurant, Nouilles Ceintures, you may wish to complete your menu by ordering starters such as a celery and peanut salad or a mushroom and chives salad (there is no dessert on the menu). Eating the XL noodles or slurping them is quite a mouth-muscle exercise, while trying to resist the chilli and to catch the cabbage leaves you certainly need a fork and a knife, instead of wooden sticks. At the end of this absorption exercise you can rush to take fresh and crispy salads, with a lightly sweetened sauce, or to soft and also cracking Chinese mushrooms, called "ears of Judas", sweet and spicy. A much less straining exercise is to choose narrow noodles with vegetables, without broth or chilli. These two examples of simple and authentic Chinese cuisine in Paris cannot hide the fact that, with the mushrooming growth of Asian cuisine of all kinds, the newcomer may be confused and, for instance, thinks that Cantonese rice (invented in France), *nems* (Vietnamese), curries (Indian or Thai) and even *sushis* are all Chinese meals. But even though the authenticity of Asian cuisine has often been modified, simplified or altered, there is still room for a new wave of a mouthwatering and trustworthy gastronomy (Labro, 2018c).

Therefore, the main question is: "When we talk about Asian cuisine, about what are we talking?" asked Julien Pham, the founder of the culinary agency Phamily First. "Nobody talks about a 'European cuisine', because there is no commonality between a Spanish *paella* and *haggis* – a Scottish meal, consisting of a ewe's stuffed stomach. We still have the stereotype of Asian restaurants, i.e. cheap eating places where a hodgepodge of Thai, Chinese and Vietnamese meals are served, with a *sushi-yakitori* in a corner, this is meaningless!" he explained. If this kind of hodgepodge recalls the former "Chinese restaurant", there are nowadays modern authentic Chinese ones, such as the Panasia chain which serves fried chicken, as well as *sushis*, wok noodles, sweet and salted salads, raviolis or pancakes spiced with *kimchi*. For those who tried it, "it seems to be well done," stated Julien Pham. The latter was nevertheless of the opinion that time has

come to clean up the landscape, and "propose something new, fresh, special, without altering the spirit of the cuisine of our mothers. Today, the public is ready for that," said Julien Pham and his sister Céline (Labro, 2018c).

Peking duck: an old Chinese culinary tradition revisited in France

The Peking duck is the flagship product of Chinese gastronomy across the world. "Paris has its roasted duckling served at La-Tour-d'Argent restaurant and Peking has its Peking duck at the Quanjude restaurant," summarized William Chan Tat Chuen, a specialist of China and food cultures and rituals. Not to mention the supposed role in diplomacy of the Peking duck. When in 1971 Henry Kissinger – President Richard Nixon's national security adviser – secretly visited Peking to meet with China's prime minister, Zhou Enlai, he was invited by his host to eat a Peking duck. H. Kissinger was fascinated by the meal and he stated: "Control the oil and you will control the nations, control the food and you will control the peoples." The immediate result of this visit was the concrete preparation of a visit to China of President R. Nixon. H. Kissinger would have enthusiastically said: "After a Peking duck, I agree on everything" (Nasi, 2018a).

Traces of this Chinese meal go back to the 4th century during the dynasties of North and South China. But we had to wait for emperor Qianlong and empress Cixi, who craved for the duck, to see the brilliant success of the poultry; and in 1864, the restaurant Quanjude was opened and since then it is considered as the Mecca of the Peking duck. Nowadays, this restaurant has about 50 subsidiaries across China which serve more than two million ducks to five million clients each year; it has even a duck museum. The mother institution is a seven-floor building with an area of 15,000 m^2, near the Tiananmen Square. The duck that is cooked in China belongs to the species *Anas platyrhynchos domestica*, or Peking duck, with snow-white feathers and an orange beak. "This species has a soft and fatty flesh; it was discovered during a hunting party of emperor Qianlong in Mandchuria," recalls Christopher Zhao, an influential Chinese culinary blogger (Nasi, 2018a).

Raised in the open air during two months, the ducks are thereafter force-fed. "They must reach the ideal weight of 2 kg", said Margot Zhang, the grand-daughter of a duck breeder. Then they are slaughtered, plucked and cleaned out and swollen – air is pushed between the skin and the underlying fat. "The best roasters only use their own mouth to do so. The ducks are put in boiling water, dried, covered with maltose and roasted during 40 to 50 minutes. The skin must be crispy and red like a date, and the meat containing small cushions of fat should be juicy and melting in the mouth," indicated William Chan Tat Chuen (Nasi, 2018). The Peking duck is cut in front of each restaurant's client: a cook wearing a chef's hat and white gloves slices the duck and at least 100 slices should be made, preferably 108, because the Chinese people like number 8, meaning good luck. The slices are wrapped in a pancake made of wheat flour and soaked in a sweet sauce, containing chives, cucumbers and other pickled vegetables. This kind of preparation tends to mitigate the savour of fat. At Quanjude, the clients are given a small card indicating the number of the Peking duck they have tasted. Like all other state-owned restaurants, Quanjude was hit by the liberalization

wave of the 1990s. The best chefs left and were recruited by private restaurants; that was the case of Dong Zhanxiang, who worked for Quanjude, before founding Da Dong, the other flagship restaurant for Peking duck, which opened an outlet in New York during the spring of 2018. While Quanjude is attended by the Chinese middle class, Da Dong aims to be more sophisticated. "Big" Dong, who is 1.93-m tall and a friend of Alain Ducasse, dares to distanciate himself from tradition. For instance, to make the duck's skin crispier his clients soak it in sugar cristals. The chef even changed the roasting technique – raising the time of roasting up to 70 minutes – in order to obtain a crispier and less fatty meat (Nasi, 2018a).

"Duckling au sang" at Paris La-Tour-d'Argent restaurant

Very few Parisian restaurants have been so closely identified with a flagship meal and the way it is served. This is the case of La-Tour-d'Argent, the dining room of which is located on the sixth floor of a building, with an extraordinary panoramic view over the City Island and Notre-Dame cathedral. The recipe of La-Tour-d'Argent duckling was developed by the end of the 19th century by the owner of the restaurant at that time, Frédéric Delair, a man from Rouen, in Normandy, who brought back to the Left River Bank of Paris the regional gastronomic speciality called the duckling au sang – i.e. cooked in its blood. F. Delair was also the man who has fixed, since 1890, the rules of slicing the duckling; and he used to give each client the identification number of the poultry eaten. For instance, in 1890, the Prince of Wales, the future Edward the VIIth, King of the United Kingdom, savoured the duckling no. 328. In 1914, it was the King of Spain, Alphonso XIII, who tasted the ducking no. 40,312, while in 1921 the future Japan's emperor, Hiro Hito, had on his table the duckling no. 53,211. The gastronomic columnist of the French daily newspaper *Le Monde*, Stéphane Davet, enjoyed eating the duckling no. 1,164,350, prepared in the kitchen of La Tour-d'Argent during the autumn of 2018 (Davet, 2018).

Until the beginning of the 21st century, there was no great change. The ceremony consisted of presenting the roasted duckling to the clients; then on a bar located in the middle of the dining room, the chef took off the legs of the poultry – sent back to the kitchen and thereafter grilled and served during a second service; the chef could then slice the filets of the duckling and set them on a main dish placed over a small stove, along with the duck's liver-paté, cognac, Madeira wine and lemon juice. On the other hand, the duckling's carcass is mashed in a silver screw press; the juice extracted is mixed with a glass of consommé and then with the other ingredients on the main dish, and the whole mixture is converted into a sauce having the texture of melted chocolate. The duckling's filets, wrapped in this sauce, are always served with soufflé potatoes (Davet, 2018).

The duckling must be ordered two days before attending the restaurant for a party of two persons or more, and it cost *ca*. €220 per person (in 2018). Philippe Labbé, La-Tour-d'Argent's chef since 2016 explained: "With an output of 80 ducklings sold per service, this emblematic meal has been progressively assimilated to a cosy café's meal or dish, deprived of elegance and grandness." The restaurant, which may have been created in 1580, needed to regenerate a gastronomic style which tended

to become that of a museum. After having been a symbol of Parisian gastronomic excellence over decades, this three-Michelin star restaurant lost one of them in 1983 and a second one in 2006. Further to his grandfather who bought the restaurant in 1911 and to his father Claude Térail who, from 1947 to the mid-2000s, has hosted a great number of connaisseurs, André Térail – 40-years old in 2020 – has inherited a monument that should not become an ivory tower. He relied on the new chef Philippe Labbé – 59-years old in 2020 – to give a new luster to that historic place (Davet, 2018).

Philippe Labbé has worked at the Shangri-La Hotel – in the 16th district of Paris – where he was awarded two stars by the Michelin guide and became the chef of the year 2013 (French gastronomic guide Gault & Millau). He was of the opinion that the duckling meal "could cause other feelings, rich in surprises," and he designed an "all-duck" menu, that cost €360 per person in 2018. Since the early 1960s, P. Labbé has been supplied by the Burgaud company, located in Challans, Vendée region, centrewest of France. The ducks are derived from crossings between the mallard and several regional breeds. On the one hand, the chef prepares the duck's prime pieces (or titbit) according to well-known gastronomic traditions – e.g. stripes of breast, roasted and cooked in candied quince; confit-of-duck-leg royale, cappuccino of potatoes and bitter cocoa, slice of bread with truffles; roasted filet with sweet (vernal) grass and hydromel, flat peach and rhubarb. On the other hand, he innovates and makes such dishes as a tartare of duck filet, lobster and gamberoni, in a very warm broth, *shabu-shabu* type; duck supreme, thick and tender, cooked with a chocolate crust and game aromas. The duck liver-paté is also garnished with truffles and served according to a long-standing tradition of the restaurant, or with some kind of innovation like an oyster vinaigrette or a cucumber jelly. Philippe Labbé, according to Stéphane Davet (2018), makes his bold creations thanks to a perfect cooking and seasoning. But it is, when applying to the duck the same old saying about the pig "everything is good in the duckling," that he is really amazing. P. Labbé became particularly aware of this approach in Shanghai, Peking or Hong Kong where he spent some time further to Shangri-La owners' initiative. There are in fact in the Chinese cuisine so many and amazing ways to preserve and use all the duck's pieces, that have impressed P. Labbé and certainly inspire him today (Davet, 2018).

Japanese touch and refinement

It is a fact of life that savours, flavours and gastronomic approaches have been disseminated throughout Europe and, sometimes, they have been dovetailed with the eating and drinking habits of many people. For instance, soybean sauce happens to be side by side with olive oil, while rice vinegar is next to sherry vinegar in local groceries. The same is true of *ponzu* sauce, *yuzu* juice, broths, *miso* – condiment made of fermented soya sauce –, *shiso*, dried algae, fresh or marinated ginger, coco milk, *nuoc-mam* – fish sauce macerated in brine –, *wasabi* – hot horse radish paste –, coriander and lemon grass, Sichuan's chilli or black pepper. The Asian products have been mushrooming, such as wheat, rice or buckwheat noodles, long or round rice, black and green teas, *tofu* (soya paste), *shiitake* (Asian mushrooms), black garlic and fried onions, mangoes and litchis. And they are sold in supermarkets as well as in "Asian delicatessen" boutiques, which can be found in all French cities, for instance in

Paris, from Belleville in the north of the town to the Choisy triangle; in Toulouse, Lille, at Tang Frères Paris store or Supermarket Asia (Lyon). According to Ryoko Sekiguchi, a Japanese gastronome, the fascination of French people for Japan is just 30-years old, and it is closely associated with the cultural bridges that have been built between both countries, thanks to the *manga* (Japanese cartoon) culture. "French is the world's second-biggest consumer of Japanese cartoons after Japan itself. The present generation has grown up with it and so the Japanese daily life has been stamped in its mindset, starting with Japanese gastronomy. These readers or spectators were already nostalgic, before tasting the cuisine … Nothing is more familiar to them than sticks and a bowl of rise", she stated. And tastes are changing along with eating habits: some drink tea with cheese and others drink sake with their main meal. Cooking is made in a wok (deep frying pan) and the rice-cooker is praised by many. A chic tasteful dinner or lunch can consist of raw fish and *sashimi* – minced raw fish with ginger and horseradish –, or of a *wagyu*-beef steak or a traditional duck (Labro, 2018b).

It is also true that many market gardeners in the French rural areas are expressing their passion for Far-East vegetables: they grow exotic herbs, cabbage, horse radish, Chinese sweet potato or Hokkaido pumpkins, that have special flavours and savours. As stated by Annie Bertin, a farmer in Brettany, "the clients, chefs or individuals, are increasingly fond of these different tastes." On the other hand, a small market gardener, Jean-Philippe Agnese, said: "I grow Asian vegetables because I also love their spirit." Camille Labro (2018b), quoting these statements, concluded that the Zen spirit and authentic savours and flavours are intimately associated with this new culinary era. Thus, two simple examples of Japanese meals or dishes can illustrate the so-called Japanese touch and refinement. The first one is the story by Camille Labro (2018e) of Adrienne Saulnier-Blache who exports French wines to Japan and imports excellent sakes. Her ancestor, Louis Nicolas, founded in 1822 a company bearing his name and involved in the wine business. The company was thereafter owned by the grand-grandfather of Adrienne Saulnier-Blache, Etienne Nicolas. He had a vision for the company, while he started delivering wines using a tricycle in the 1920s. Adrienne's father worked for Etienne and he learnt a lot about the profession: they used to buy wines across the whole of France, tasted and selected the wines that should bear the name of Nicolas. The company was sold to the wine-making and business group Castel and it became the wide-spreading Nicolas company all over the country and even beyond. Meanwhile, Adrienne's father migrated to the south of France by the early 1960s to make wine and to struggle for the award of the *appellation contrôlée* label – official certification guaranteeing the quality of the produce – to the wines made in the south of the country. Adrienne's mother belonged to the high gentry of Tokyo; she arrived in France in 1968 with a view to studying art history and she decided to stay in this country she loved very much. She suggested to her husband to export French wines to Japan and that was successful. Adrienne Saulnier-Blache spent her childhood in the Champagne area, surrounded by the finest wine-makers, and then in 2008, she officially became the owner of the company and wine-business. Five years later, she discovered the Japanese *sakes* – fermented rice beverages – made by fully committed craftsmen. In 2015, she founded the new company, Madame Sake, that imports these exquisite beverages to France (Labro, 2018e).

Sharing both French and Japanese cultures, Adrienne Saulnier-Blache was normally inclined to cook Japanese meals, e.g. *gyozas*, small raviolis, inspired from the *pierogi* or Polish raviolis, and prepared with a Polish neighbour. She also learnt from an Italian cook how to prepare *culurgiones*, raviolis from Sardinia made of potatoes with mint. The Japanese *gyozas* are made of a thin paste that wraps a mixture of minced and salted cabbage, ginger, spring onion (scallion), coriander, rocket (arugula), and of ground pork, hand-kneaded for several minutes. Sesame oil and soya sauce give the final touch to the mixture. The *gyozas* are cooked in a pan at high temperature. Once roasted they are seasoned with a drop of peppered oil or with a mixture of soya sauce and rice vinegar. Adrienne Saulnier-Blache recommends to taste the *gyozas* with a good sake such as the Yamagata Masamune Kimoto 1898 (Labro, 2018e).

Japanese cuisine is very rich in culinary preparations, it contains a variety of ingredients and is always presented with a sense of aesthetic refinement. It includes a variety of traditional pastries, called *wagashis*, which quite often are eaten during the tea ceremony. In Japan, sugar is considered a sacred item. The *wagashis* were made during the 16th century, when the exchanges with China were becoming more numerous and closer; the pastries were first conceived with a view to accompanying the zen art of tea and to enhancing, thanks to their sweetness and aesthetics, the bitterness and purity of the beverage. The main ingredients of the *wagashis* are *azuki* beans (red or white), organic sugars, rice flour and jellifying algae (agar-agar); their colours and shapes echoe the seasons, the natural environment, the birds, wind and light. In a country where the usual dessert does not exist, these poetic creations or *wagashis* are admired and savoured. In Kyoto, near the old imperial palace, the Toraya shop has been preparing these *wagashis* for four centuries; the shop includes an elegant sales place, a tea lounge, an art gallery and a garden where one can wander and meditate about the symbolic significance and refinement of the sweets, purchased to take home or to be consumed on the spot (Labro, 2018b).

Blending teas and meals

On 19 November 2018, at the school Cordon Bleu in Paris, Shuzo Nagumo, considered the best Japanese "blender" of his generation, was giving a master class on the matching between Japanese green-tea cocktails and French cuisine. The "blender" who runs the Mixology Laboratory in Tokyo uses a bamboo-made pair of tweezers to deposit a few bits of golden leaf at the surface of a green cocktail made of vodka, passion-fruit juice, coco water, vanilla syrup and ground tea called *matcha*. The latter is a powder of green-tea leaves ground with a stone-grinding wheel; it is a major element of the tea ceremony. This cocktail (original creation) cannot be served without its solid equivalent: almond milk jelly with coconut, mango and passion fruit, prepared by Masiko Idaka, the pastry cook of the ES Restaurant in Paris (Bourdin, 2018). During the festival "Japonisme 2018" – which celebrated the 160th anniversary of the establishment of diplomatic relations between Japan and France – green tea was on the menu of about 20 French and Japanese restaurants in Paris during the whole month of December 2018. This event showed that this beverage was not exclusively reserved to private connaisseurs. Asian teas indeed are now regarded as gastronomic objects *per se*; they may include great Chinese brands, Japanese *matcha* or green,

white-yellow and black teas – depending on their degree of oxidation. The chefs utilize this wide variety of teas to match salted meals or they cook them and spray them directly on the plate. For instance, at the Ecrin, the star-Michelin-awarded restaurant of the Hotel de Crillon, located in Place de la Concorde, Paris, the sommelier, Xavier Thuizat, suggests to match some dishes of the degustation menu with teas of great origin (Bourdin, 2018).

Lydia Gautier (2005), a French agronomist, who first worked in the wine-making business and, since 1995, she has pursued her career in the tea business, before living in Mali (West Africa) with her family for five years. In Mali, people are big consumers of tea – a heritage of the nomadic touareg culture. It was in this African country that she started to write on the subject of tea, and she carried out consulting work, in particular for NGOs that develop tea-value chains. She also connects tea producers with connaisseurs or consumers eager to learn more about tea and its place in gastronomy. In October 2008, she co-authored with Jean-François Mallet a book titled *Thés et mets*: *subtiles alliances* – Teas And Meals: Subtle Alliances – where she demonstrates that tea is a real gastronomic product; its aromatic range is as broad as that of wine. Like wine, tea has its terroirs, its vintages and appellations, and it can be perfectly matched with meals. She proposed the combination of 50 tea varieties with 500 traditional meals – salted or sweet – (Gautier and Mallet, 2008). Lydia Gautier made many statements on the subject, like: "Tea should be considered as a gastronomic ally, as much as wine" … "I wish that good tea be found outside the premises of luxury-hotel restaurants." In 2018, L. Gautier published another book titled *Portraits de thé, voyage dans 40 pays producteurs* – Tea Portraits, Journeys In 40 Producing Countries (Gautier, 2018).

The trend of associating tea with meals is in full swing. Lydia Gautier explained: "In France, the idea to associate tea with meals was suggested in the 1980s, upon the initiative of tea lounges. In 2009, with the opening of the Yam'Tcha restaurant, owned by Adeline Grattard, it became possible to taste more complex associations between teas of famous origins or provenances and Asia-influenced gastronomic meals." According to the Yam'Tcha's sommelier, Chi Wah Chan, tea is best appreciated when it is served separately, harmoniously matching the meals. Tea also conveys a feeling of well-being, as it is a source of vitamins and antioxidants. Some chefs use tea in their recipes. For instance, Guy Martin, from the renowned restaurant le Grand Véfour, in the centre of Paris, revisits the famous marbled egg of the Chinese cuisine, that is macerated during a whole night in a Chinese great Sichuan black tea; the meal is garnished with cannellonis stuffed with leeks, *udon* noodles and a *wasabi*-yogurt sauce. At the Prince de Galles Hotel, near the upper end of the Champs-Elysées, in its restaurant La Seine, Stéphanie Le Quellec prepares a *matcha* green-tea with a jellifying alga in order to give more taste to a dish of prawns. "Tea is used like an aromatic plant: infused in broths and sauces, or dried and powdered on the meals like a spice," stated Eric Frechon of the three-star restaurant Epicure at the Bristol Hotel, not very far from the lower end of the Champs-Elysées. In order to foster the creativity of his team he decided to set up a cupboard filled with 50 tea varieties in his kitchen (Bourdin, 2018).

It is true that French cooks are trying to master the methods of tea preparation – maceration, infusion or powdering – but it takes time; hence the need for training or initiation courses to understand the tea uses, e.g. at the cooking school Ferrandi. At La Table restaurant, the chef Junko Kawasaki revisits the codes of tea, learnt in Japan. She prefers to use the plant because of its virtues of taste and decoration. Her last pastry creation shows the beauty of green tea in its most minimal and poetic expression; it is a mont-blanc with chestnut cream, garnished with meringue and a core of melting raspberry; the pastry, covered by a three-layer powder of glittering green-tea, has been named Mount Fuji (Bourdin, 2018).

Raw food trend

Eating raw food has become trendy and it applies to raw animal-derived foodstuffs like fish as well as to vegetables and other plant-derived food. In both cases, it has to do with healthier food, including raw products, perfectly traceable, sold through short commercial circuits, organic and that have been submitted to a pesticide minimal treatment. From the nutritional viewpoint, eating raw food is justified by the fact that fruit and vegetables lose their vitamins, enzymes, antioxidants, mineral salts – and almost their healthy nutrients –when put in boiling water, while raw food conserve, by contrast, all these nutrients. Once this is agreed, there is a wide variety of diets, from a strict raw diet to a balanced growing proportion of raw products that are not processed beyond 42°C – the frontier temperature between raw and cooked food (Géné, 2016e). Vegetarians and vegans are historically the big consumers of raw food, because of health reasons and ethical principles – rejection of all products of animal origin. Initially, raw food was a wonder diet, promoted by Ann Wigmore, born in Lithuania and then living in Massachusetts (Boston), who claimed that she had recovered from two cancers thanks to a treatment based on herbs and plants, inherited from her grandmother. This approach still goes on, through her own foundation and the Natural Health Institute. The latter was moved to Porto Rico, where "the warmer weather facilitated the treatment." Despite the doubts about this approach to curing major diseases, the belief remains, e.g. in California: such a raw diet can help in getting rid of some kinds of illnesses, as it was the belief of a few renowned actors and actresses from Hollywood (Géné, 2016e).

Regarding Europe, J.P. Géné (2016e) indicates that William and Marie Pradelaix, after having traveled from San Francisco to Bora-Bora (Polynesia), opened in 2016 a bar-restaurant in the 3rd district of Paris, which serves only raw food. The chef in charge of this bar-restaurant wants to take some distance from the Japanese *sashimi-wasabi* or the Peruvian *ceviche* fish, olive oil, red onion, salt and lemon juice. "They work on the seasonings, the vinaigrettes, the mixture of savours and textures, in order to show that it is possible to have a real treat while eating raw foodstuffs," they stated (Géné, 2016e). Another address in Paris offers the following meals: pineapple gaspacho, cold cucumber, ginger and watermelon candy; tuna tartare, garnished with cucumber, chilli, coco milk and lime (Tahitian style); *barramundi sashimi*, with mango pickles, vinaigrette, chives, truffle and eggs of exocet – a flying fish; organic shrimp *ceviche*, fresh green peas, vinaigrette, curcuma, potato, green apple. These menus are very tasteful, especially during the summer. René Redzepi, the renowned chef of the Noma

restaurant in Copenhagen, has been organizing every year, since 2009, a seminar called Cook it raw, that is attended by young chefs from across the world; they are trained to use homegrown foodstuffs with a minimum processing. For the first time, R. Redzepi served there its olive and raw shrimp from the fjord, which has become since then a classic item on his menu (Géné, 2016e).

According to Mintel – the world's agency specialized in market studies – the vegetarians and vegans are "naturally" raw-food eaters, but this kind of diet has an increasing growth rate among those consumers who are looking for safe and healthy products, additive-free, and who try to escape the pressure of the agroindustry and the large food-distribution networks. The high growth rate of consumption of cheese made from crude milk (from 5% in 2012 to 9% in 2015) or of raw chocolate – 56% of interviewed people were willing to taste it –, as well as the circular economy between farmers and consumers are good signals toward a healthy and tasteful diet (Géné, 2016e).

A few trendy and surprising eating experiences

New roles for chefs in a globalized gastronomy

In September 2016, the restaurant The Bunyadi moved from London to Paris because of a heat wave that hit the British capital and because of a lack of an appropriate air conditioning. This 42-seat ephemeral restaurant – 46,000 clients were on a waiting list by September 2016 – welcomes its guests who must take off their clothes and leave them in the cloakroom and should bring with them a towel to be laid on their respective chairs. In addition to this hygiene precaution, cell phones are forbidden; there was neither gas nor electricity, but candles to light up the tables; bamboo furniture, organic food, cooking on charcoal fire, vegan menu or else, the final objective being to be as close to "nature" as possible. This is the meaning of the hindi word *bunyadi*. Seb Lyall, the inventor of the "concept", may be a weird provocateur or a forward-looking genius, but he obviously belongs to the trend aiming to make every meal eaten in a restaurant a real "experience" (Géné, 2016f).

Such an "experience" firstly includes the table set: e.g. a table hung with a crane at a 50-meter height, the meal served in a room decorated with salt (in Shiraz, Iran) or set up in an igloo (La Plagne, in the French Savoy), or even under the water in a lagoon, at the Hurawalhi Island Resort in the Maldives. At the gastronomic restaurant La Ferme de mon père (My Father's Farm), owned by the French chef Marc Veyrat and located in Megève (Higher Savoy), the clients used to dine on a glass floor above a refurbished stable – this restaurant has been sold out. Secondly, it affords a special atmosphere: e.g. in Shanghai, the chef of the Ultraviolet restaurant, Pau Pairet, carries his ten guests in a minibus to a secret place, with no windows or openings, where they will be able to go through an experience of appreciating 22 levels of tastes, for about four or five hours; also, they will be submitted to a variety of images, sounds, smells or fumes "that stimulate the five senses and increase the memory of a meal." In Miami, the chef Mark Scharaga proposes to his Kung Fu Kitchen's guests *sushis* on the body of naked women (US$500 in 2016), echoing the Japanese tradition of *nyotaimori* (meaning literally "presentation of a woman's body)". At Eleven Madison Park, a

three-star restaurant in New York, "the chefs scramble with flambéing a Norwegian omelette, the slicing of a pig's bladder stuffed with asparagus, the traditional opening of bottles like old ports – using a white-hot metal ring around the neck of the bottle, which breaks off neatly," told Nicolas Chatenier, president of the French jury of the 50 Best – the list of the world's 50 best restaurants, established by the British magazine *Restaurant*. "People were fed up with the French heavy style of serving meals, and the gastronomic restaurant should be associated with its social environment, where those clients who can afford it, want a magnificent table set-up, a good and stylish service and the best foodstuffs," he added (Géné, 2016f).

The "experience" would be incomplete without the seal of the chef who tends to become a theater person, whose first weapon is the imposed menu. It is not the client who decides, but the chef who grants you the privilege to dine at his table. It is like attending a concert, and one tastes a unique "masterpiece", designed and cooked thanks to the chef's talent. And it is true that the advertisement through the media or by other means does attract more than the the locals. Thus, people come from Argentina to attend the restaurant of Massimo Bottura – no.1 on the 50 Best list in 2016 – in Modena (Italy). The chefs have responded to the guests' mobility through a lot of destinations across the world: for already a long time ago chefs like Bocuse, Troisgros, Ducasse, Robuchon, Gagnaire, Ramsay and many others, have opened subsidiaries bearing their names. Another generation of chefs prefer to stay a few weeks in a specific location with a view to presenting their own cuisine or to applying their style to redesign the local one. For instance, René Redzepi spent a month in Tokyo in 2015, then three months in Sydney in 2016; or the English chef Heston Blumenthal – The Fat Duck, in London's suburbs – spent six months in Melbourne, Victoria, Australia, in 2015; or the Catalan chef Albert Adria – Ferran's brother, who owned the El Bulli restaurant, now closed down – spent 50 days in London in 2016; and the French great chef Hélène Darroze moves during the summer to hotel Maria Christina, in the city of San Sebastián, Basque country (Géné, 2016f).

The chefs of these pop-up restaurants are pushed to the foreground of the international stage and this explains, to a large extent, why their seats are booked up several months in advance. For instance, during his stay in Sydney, R. Redzepi could sell all the 56,000 seats available in two minutes. Such kind of behaviour seems to become quite frequent and this enables the restaurants to avoid the usual last-minute cancellations – these seriously reduce the restaurants' profits. Nicolas Chatenier, president of the French jury of the 50 Best world's competition, stated in this respect: "After all, one books a hotel room or rent a car in advance, why not a gastronomic dinner." It seems that this is the ransom for a quite unusual gastronomic "experience", but J.B. Géné, in charge at that time of the gastronomic review of the French daily newspaper *Le Monde*, thought that such a trend might imply the disappearance of the starring role of the chef who ought to be at the service of the guests (Géné, 2016f).

London: a city-wide culinary flowering

What was once a predictable dining experience in London is now full of surprises, befitting a metropolis of such diversity and ingenuity, according to Robert Draper

(2018). This holds true not only in the high-rent zones of West End, Covent Garden and Soho but also – maybe even especially – in less commercialized districts to the east, such as Shoreditch and Bethnal Green. In short, London's culinary flowering is a citywide phenomenon. For instance, R. Draper (2018) enjoyed a simple and good dinner at Shoreditch: a plate of grilled asparagus with ricotta cheese, bread crumbs and the faintest whisper of mint; at last came the entrée: a grilled pork chop from the market town of Tamworth, topped by slices of grilled peach. This was, according to him, the apotheosis of simplicity's genius. In the West End neighbourhood of Mayfair, Gymkhana is a five-year-old, Michelin-starred Indian restaurant owned by British-Indian siblings, the Sethis. Gymkhana is an ode to colonial India. Crucially, however, its cuisine does not defer to the leaden palate of old England. Instead, its flavours are aggressive and uncompromising. The culinary possibilities here seem innumerable, starting with several tasting menus – one of them consisting entirely of game – paired with a dazzling global assortment of wines by the glass. Befitting haughty Mayfair, Gymkhana is not cheap. But low-cost delicacies are available, beginning with the shrimp and mango chutney as well as the *papadums* stuffed with cassava, lentil and the palm stem extract known as *sabudana*. The game-tasting menu can be ended by the wild *muntjac biryani*, pomegranate and mint *raita* – a venison dish that is served in the form of baked bread with sesame and other seeds on top; the venison beneath the crust was even more mysterious in its spicy elaborations – cinnamon being the one recognizable flavour (Draper, 2018). See below pp. 206-207.

In Covent Garden, a high-density tourist zone replete with theaters and pub grub, Eneko is a Basque restaurant owned by Eneko Atxa. One feels like being in northern Spain. It helps to begin with a glass of one of the crisp and aromatic white wines from the owner's family vineyard, and a charcuterie plate of *chorizo*, *coppa*, *salchichón* and homemade pickles. That platter, along with charcoal-smoked potatoes and stir-fried zucchini, amounts to a light and low-cost meal. The menu called *traditional talo* turned out to be a large baked maize *tortilla* subdivided into quadrant bites covered with opulent heritage tomatoes, basil and olive emulsions, edible flowers and little caviar-like bubbles made of olive oil. It is equally hard to say no to Eneko's suckling pig *tempura* balls in a bacon sauce, the Basque-style squid in a creamy ink sauce, and a Catalonian orange wine fermented in amphorae (Draper, 2018).

In the East London neighbourhood of Bethnal Green, Michael Sager and Charlotte Wilde's four-year-old restaurant has an arched metal ceiling, candlelit tables and a wall-to-wall bar, with early-1980s New Wave music. Sager & Wilde's namesake on Hackney Road is perhaps London's most venerated wine bar. But this does not suggest that the food is beside the point here. The offerings – decidedly Mediterranean – are far more about the local ingredients than about a chef's preening. The *burrata* appetizer has accompaniments which vary according to season – apricots, pine nuts and mint, or pumpkin seeds, figs and pomegranates – but the marshalling of flavours is always a subtle revelation. The first course was pork, duck and hazelnut *agnolotti*, which was both velvety and robust. Finally, *The New York Times*' journalist opted for a small and brilliant assortment of cheeses from the English countryside (Draper, 2018).

On the trail of fine Indian food

Since the 1990s, a culinary revolution has swept through London: there has been an offer of many fine-Indian food restaurants which put aside the old curry houses where it was possible to eat well at low cost. A new generation of Indian chefs played a key role in this transformation through their spectacular display of several culinary traditions of the India sub-continent. It is now possible to list gastronomic restaurants (e.g. Chutney Mary, Amaya, Trishna, Gymkhana, Veeraswamy), exciting smaller restaurants serving light meals (e.g. Gunpowder, Dishoom, Kricket, Benares) or trendy restaurant chains (e.g. Masala Zone, Hoppers, Cinnamon Collection). Fine Indian food is now glittering along the Thames River. Nothing would have been possible without the visionary intuition of a trio of two sisters, Camellia and Namita Panjabi, and of the latter's husband, Ranjit Mathrani; the sisters were 60 years old in 2019 and Ranjit was 75. The three of them are from Bombay's gentry who came to study in Cambridge in the 1970s and 1990s, before turning their interest to the business sector. Nowadays, they lead the Masala World group and own a dozen restaurants in London. Their main focus is to rehabilitate their national cuisines: "Our ambition is to make understood that the diversity of Indian cuisine is at the scale of the complexity of a continent, and therefore much beyond a country," explained Ranjit Mathrani, a former banker who had the opportunity to attend many French star-awarded restaurants. In 1990, he launched with his wife the Chutney Mary restaurant in the district of Chelsea; this iconic restaurant moved in 2015 to the very elegant St James Street (Davet, 2019c).

"In India, the nickname Chutney Mary is given to the Indian women who want to adopt Western women's lifestyle," explained Namita Panjabi who, after a career in the design and merchandising, devoted her working life to the food business. "This is consistent with our dual identity. On the one hand, to present the authentic regional side of Indian cuisine, and on the other, to demand high-quality products and to adopt the imaginative presentation of Western gastronomy," she added. Chutney Mary is very different from the uniformity of the curry houses of the northeast of London (Brick Lane), where were ubicated most of "Indian" restaurants of the United Kingdom's capital, owned in fact by immigrants from Bangladesh, as well as 90% of the *ca*. 8,000 British curry houses. Chutney Mary has become one of the encounter places of the showbiz, finance sector and political life. The Anglo-Indian design of the restaurant is very cosy. There, the clients can taste a variety of meals, cooked for a long time and with curry sauces that represent various facets of Indian regional food, with a special endeavour made to adopt and adapt high-quality products or ingredients. Camellia Panjabi explained: "One could indentify at least 14 regional cuisines. That of Penjab is the most widely known; it includes the *tandooris*, *naans*, *makhan murg* which is a roasted rooster cooked in a spicy tomato sauce enriched with *ghee* – the Indian clarified butter. The Awadh cuisine, influenced by the Moghul cuisine, should also be discovered, as well as the meals of southern India with one of their main ingredient – coconut milk. The sweetness of Gujarat meals and the spicy touch of those of Cashmere, must also be tasted." C. Panjabi has traveled a lot across India to try to discover all regional culinary dishes and preparations. And she became the encyclopedia of the Masala World trio; in 1994, she authored, a best-seller titled *50 Great Curries of India*, with 1,5 million copies sold (Davet, 2019c).

Camellia Panjabi insisted: "We request our chefs not to cook as they may do in a hotel, but as if they cooked for their sister's wedding." Chutney Mary offers meals with a mixture of spices, generally home toasted, ground and with the correct proportions, and based on high-quality ingredients, that are not found in the curry houses, such as the flounder, lobster, foie-gras, grouse and duck – a sought and appreciated dish in the States of Kerala and Assam. In 1996, the team of Chutney Mary purchased Veeraswamy, London's oldest Indian restaurant, opened in 1926 in Regent Street. This famous address had welcomed many maharajahs and kings, within a setting of the Raj – the British colonial rule in India. Its bill of fare keeps a very renowned recipe of Anglo-Indian blending, called *mulligatawny* – a sweet and sour soup of coral-red lentils. Well-known classical dishes can also be found on the menu, such as *roghan rosh* – lamb's knuckle-joint cooked for six hours in a mixture of Cashmere spices – and a shrimp curry from Kerala. Emphasis is also laid on the cuisine of the old imperial palaces' chefs (Davet, 2019c).

In 2004, the same group launched the luxurious restaurant Amaya in the district of Belgravia. With a Michelin star awarded in 2006 this restaurant highlights the art of Indian roasting. In an open kitchen, many cooks are roasting meat and crustaceans on embers or in tandoors – deep earthenware ovens – where long skewers are dipped and roasted to suit the consumers' wishes. One cannot deny that Chutney Mary, Veeraswamy and Amaya had given a brilliant image of Indian food in London – Camellia and Namita Panjabi have received the British Empire decoration. These three restaurants are costly – in 2019, *ca*. €45 at lunchtime and more than €90 for dinner. But the Masala World group has conceived a chain of less costly restaurants: in the seven addresses of the so-called Masala Zone, the checks reached in 2019 *ca*. €25 at lunchtime and *ca*. €35 for dinner. They basically serve Indian street food and they also propose family dishes, such as *thalis* trays, consisting of bowls of cereals, vegetables, dairy products, surrounding a rice heap. At the Masala Zone restaurants, the clients can taste the *pao bhaji* – ghee toasts that are dipped in a vegetable stew – or the sprouted lentil *bhel* – a crispy sour salad consisting of germinated lentils, puffed rice and tamarind (Davet, 2019c).

Following the example of their elder fellow countrymen of the Masala World group, the Sethi family is the other driving force of Indian cuisine renovation. Gymkhana is their iconic restaurant (see above), but Trishna has also a Michelin star and it serves meals with a magnificent originality. The Sethi family also owns a less expensive restaurant, Hoppers, in London's West End, which serves Sri Lankan dishes garnished with pancakes (hopper and *dosa*) made of rice flour and coconut milk. Finally, as another example of revisited fine Indian food, the Gunpowder restaurant, near London Bridge, serves dishes that look like Spanish *tapas*: lamb chops with a spice crust, fried soft crab with a tamarind sauce and beef spare rib with Kerala pepper (Davet, 2019c).

Spain: from molecular gastronomy to authentic savours and flavours

In 2011, the famous restaurant El Bulli, owned by Ferran Adria, closed down. The Catalan chef, the father of a "techno-emotional" cuisine with a thousand of molecular offerings – revered by some and criticized by others – announced the reopening of

his restaurant in 2014 as a foundation. It is still awaited and, meanwhile, Spanish gastronomy is returning to basics. It should be recalled that the culinary extraordinary creativity that was prevailing during the 1980s with a generation of famous chefs, has superseded the French sophisticated gastronomy, according to an Anglo-Saxon food and wine critics of that modernist period. At the beginning of the 2000s, the French gastronomic guide Michelin awarded many stars beyond the Pyreneans and El Bulli has been qualifed "the finest restaurant in the world" by the British magazine *Restaurant*, that started to launch its world's ranking "50 Best" (Labro, 2017a).

Nowadays, Spain, with the United States and France, remain among the overrepresented countries in this famous – and sometimes controversial – ranking that indeed has always privileged "innovative" tasting menus. Three restaurants were among the top ten: El Celler de Can Roca (3rd), Asador Etxebarri (6th) and Mugaritz (9th). It was therefore no surprise that the "50 Best" gala was to take place in Bilbao during the spring of 2018. That same year was celebrated in the capital of Biscaya, the 20th anniversary of the Guggenheim Museum – the monument built by the American architect Frank Gehry and that has completely transformed the city, with flocks of tourists coming to admire and visit the monument as well as to appreciate the Basque cuisine. For instance, the chef Josean Alija who owns the restaurant Nerua, located inside the museum, invited renowned chefs and friends to participate in magnificent dinners. The first guest among them came in May 2017: it was Joan Roca, the chef of El Celler de Can Roca, located in Gerona, Catalonia, and considered one of the "brains" with F. Adria behind the creative trend of the Spanish cuisine. But by contrast with molecular gastronomy promoted by F. Adria, the tasting menu included consommés with tear-like green peas, fermented mackerel, shrimps cooked in many ways, plant or marine broths … One had the feeling that the previous trend of complexity, mixed with bold technical achievements that made famous the Spanish "new cuisine", had to be revisited: "the product, the essence, the season, the search for purity and refinement, and for real tastes," are the goals, said Josean Alija, who made it very clear that he never puts more than three ingredients on the same dish. He anchored his cuisine in the Basque tradition with a view to discovering new meals (Labro, 2017a).

It is true that there is a real and permanent tension between tradition and innovation in the present discourse of the Spanish chefs. It is worth mentioning the case of the chef Quique Dacosta who has been at the helm of molecular gastronomy and is now changing gears. In his star-awarded restaurant, south of Valencia on the Costa Blanca, he welcomes his distinguished guests, during the first night, while cooking two key products of the region: rice and shrimps. Standing up, the guests can taste red *gambas*, *tempura*-cooked, as well as several types of caramelized rice, i.e. recipes that are not listed on the restaurant's menu. It is a way to discover the essence of rice-based meals (*arroces*). The chef intends to open a restaurant in London dedicated to them. Quique Dacosta is very eager to explore, and add value to, his region's culinary traditions and products. The menu he serves has six meals: salted and pressed mullet or ling roe, sun-dried octopus, fresh shrimps, fresh almonds, Benaguasil pumpkin, artichokes and marine herbs. He named this menu "the search for DNA" and the chef who invented the "edible landscapes" in the early 2000s, is now more interested in talking about the "landscapes" which are close to him. He sometimes could seem paradoxical when he

stated: "The Spanish avant-garde movement does not exist anymore, but I remain an avant-gardist, because I am always searching" (Labro, 2017a).

Such a paradox still exists in Spain. For instance, while in Madrid it is fashionable to be amazed by the culinary and technical extravagances of David Muñoz, the owner of the triple-star restaurant DiverXO, there is a growing tend, like in Barcelona, of a simple and tasteful cuisine that prevails in wine bars, including revisited popular meals. It seems that it is about time to come back to more simplicity, authenticity and humility. By the end of the 1990s, Andoni Luis Aduriz, the founder chef of the restaurant Mugaritz, located on the hills of San-Sebastián, in the Basque county (Guipzcoa), did understand the message. Eating in his restaurant should take less than four hours and this should be a "sensory venture", floating between "poetry, surprise, refinement and restraint", Andoni Luis Aduriz said. His tasting menu that has about 20 servings has been downsized in order to be close to Japanese minimalism: no more texturizing or jellifying molecules, aromatic balls or spectacular and very sophisticated bouchées; also the silverware is excluded and even the desserts are off the menu; people eat with their fingers "in order to have a close contact with the food, as well as the full experience of tasting *tapas* and *pintxos*." In other words, the snobbish approach to tasting is left aside, without being provocative (Labro, 2017a). Such strange or familiar meals like asparagus filaments garnished with *garum* – a fermented concentrate of anchovies –, crispy chip cooked in duck juice, broth of vegetables seeds, swollen bread garnished with salted and pressed mullet roe, fried anchovies, lettuce heart with *chorizo*, candied garlic soup, a juicy apple covered with a down of noble mould (like a cheese), are prepared hours or even days before being served, by a team of forward-looking chefs. And all this endeavour is meant to lead to clearcut savours, understandable products, and true consistencies and shapes. This overall effort aims to obtain more tastes and pleasure, that the former molecular and too sophisticated gastronomy had forgotten to provide (Labro, 2017a).

A few words about the six flagship meals or ingredients of today's and tomorrow's Spanish cuisine. First, rice which can be found in all meals in the region of Valencia (centraleastern coast of Spain); ten varieties of rice are being cultivated and a thousand of recipes exist, but only one single way of cooking it. In a very large panhandle – called *paella*, that gave the name to the meal cooked inside – rice is disposed in very thin layers and simmers in a fatty and juicy broth, without any water and without stirring. To the rice are added, depending on the recipe, artichokes, beans, onions, chilli or sweet peppers, seafood, meats, offals, snails and spices. When the broth is evaporated, rice forms a crispy crust at the bottom of the panhandle: the so-called and sought after *socarat* (Labro, 2017a). Secondly, the salty and pressed fish roe, air dried whenever possible. In the fish market one can find the salty and pressed roe of mullet or ling, but also of the seabass, hake and bonito. This ingredient is very rich in iodine and, as a condiment, it is eaten with bread slices, or pasta, vegetables, and sometimes as a snack with fried almonds. Thirdly, the large shrimp or *gamba* (prawn), found along the Mediterranean coasts – e.g. the *gamberoni* of the Gulf of Genoa or the red *gamba* of the Costa Blanca, region of Valencia. The large shrimp found at Denia, Costa Blanca, is fished in deep sea and has a very delicate taste. It is recommended to cook it rapidly in the steam of seawater, or as *tempura* – fried in boiling oil – or just eat it raw as soon

as it is withdrawn from the fishing nets. Fourthly, anchovies, fatty and stout, are really a royal festin. A traditional and very old way of preserving them consists of taking off the heads of the fish and of layering them in salt during almost a year; thereafter, they are manually taken off one by one, aligned in small cans and covered with olive oil. Tasted as such, they melt in the mouth (Labro, 2017a).

Fifthly, the so-called *guisantes lágrimas*, or tear-like green peas, are non-matured peas which have not yet produced starch. During springtime, the Spanish chefs struggle to find them on the local markets and cook them. Along the Basque Coast, those peas (*Pisum sativum*) belonging to the varieties Prince Albert or Merveille de Kelvedon, grow in a wet climate and with a saline atmosphere that gives them a delicate scent. The harvest of these peas must be carried out on a precise day and before dawn, so that the peas have the perfect size and have not been heated by sunlight. It is a luxury product, that is compared with a plant caviar; the pods are cooked in soups or broths. Sixthly, the *guindillas*, which are small sweet and green peppers, grown in the Basque country; they are also called *piparras*. They can be part of *tapas*, fried or grilled, preserved in vinegar; with olives and anchovies they make mouthwatering kebabs, or they garnish sandwiches. They bring a feeling of crunchiness and bitterness, with sometimes a surprise when there is among them a hot chilli (Labro, 2017a).

In addition to these six flagship meals or ingredients of Spanish contemporary cuisine, it is compulsory to mention the Iberian pig (*cerdo ibérico* in Spanish) ham that is considered as the "King" of *tapas* (snacks). Cut by a very skilful and experienced person (*cortador* meaning cutter in Spanish), along the animal's leg, the short and thin shavings of the ham look translucent and brilliant; their overall burgundy colour is striated with ivory streaks. These shavings or cuts are generally picked up by customers between the thumb and index, and melt on the tongue, giving savours combining hazelnut, *rancio* (rancid) – due to the delicate fat oxidation – and the voluptuous *umami*, highly appreciated by the Japanese people. These Iberian ham cuts are ideally tasted at a temperature between 20°C and 24°C in order to feel their melting in the mouth. The Iberian pig ham should not be confused with the so-called *serrano* ham produced, as its name indicates, in the mountainous regions of southern Spain. This ham is manufactured on an industrial scale and has been commercialized throughout Europe before the Iberian pig ham, called *pata negra* (black-legged). The *serrano* ham met with the European Union (EU) food standards before did the *pata negra*. But, since 1986 when Spain joined the EU, the *pata negra* has been able to overcome trade barriers and has been increasingly appreciated by the connaisseurs of Spanish delicatessen (Davet, 2020).

The balck-legged Iberian pig can be recognized by its straight back, its long snout and hanging ears covered with black hair, the black stains at the end of the legs (hence the name *pata negra*) and longer thighs than other pig breeds. The animal, of which the likely ancestor was a wild boar, walks high on its hoofs and roams around 14 km a day searching for food in clear woodlands, called *dehesas* in Spanish. These woodland ecosystems extend on tens of thousands hectares in the southwest of the Iberian Peninsula. These are *ca*. 30 trees, mainly holm and cork oaks, per hectare. These ecosystems have been modified by human activities since the Roman period

and they are typical Mediterranean biomes. They provide the feeds of the Iberian pigs: grass and acorns. The animals are free to roam the woodlands between October and the beginning of March (this period is called the *montanera*, the Spanish name derived from the word mountain). The pigs eat a big quantity of acorns which they peel off with their teeth and expel the ogive-shaped of the acorn-bark (Davet, 2020).

This form of animal husbandry and feeding throughout natural ecosystems is a millenary tradition that has been conserved in the southwest of the Iberian Peninsula, whereas it disappeared in most European countries. During the few months of husbandry in the *dehesas*, each pig grazes on *ca*. 2 hectares and eats *ca*. 700 kg of acorns, its weight increasing from 90 kg to more than 160 kg. This kind of natural "force-feeding", mainly based on acorns, has led to qualify these Iberian pigs as "olive tree on legs", because of the chemical composition of the fat accumulated by the animal: mainly oleic acid. The unsaturated fatty acid derived from the acorns is the same as in the olive or olive oil. It gives a special savour to the taste of the Iberian ham where the fat deeply penetrates the animal's muscular fibres (Davet, 2020).

Northwest of Seville, Andalucía, the village of Jabugo in the mountainous region of Aracena, in the province of Huelva, is an important production centre of Iberian ham. Other production centres are located in the *dehesas* of the provinces of Extremadura, Salamanca (Guijuelo) and in the valley of Pedroches, near Cordoba (Andalucía). The appellation of controlled origin (AOC) *pata negra bellota – bellota* means acorn in Spanish – is awarded to the pigs that are the offspring of 100% Iberian sows and boars, raised in the open air and fed with grass and acorns during at least two months. In 2014, a royal decree awarded a black label to the hams derived from these 100% Iberian pigs. The same decree subdivided the "Iberian" appellation into three other categories: a red label certifies that the hams are produced by animals fed with grass and acorns, but of which the boar is a white pig or half-Iberian. The green label certifies a ham produced by a pig breed raised in the open air, but fed with a mixture of acorns, grass and cereals. And the white label means that the ham comes from any pig breed raised in pigsties and not fed with grass and acorns. The black-labeled hams amount to 10% of *ca*. 6 million Iberian hams sold every year; they are four times more expensive than the lowest category and are considered a luxury product. By contrast to the massive roundness of the famous Italian hams, Parma and San Daniele, the Iberian ham has the shape of a V, tapering till the end of the black leg (Davet, 2020).

Hams are dried while suspended from the ceilings of many rooms and thereafter they are transferred to cellars which look like underground cathedrals and where they are suspended on strings exposed to air flowing through windows oriented to the north or south, so as to regulate air temperature from 12°C to 20°C. During the three years of maturing, hams are displaced about 20 times and hung at different heights in the cellars; they are thus exposed to air flow at distinct temperatures. The moulds growing at the ham surface are regularly checked with a view to monitoring meat maturation. Those in charge of this monitoring make several tests: the ham's pope's eye or cushion should be dry but not too much; when pressed with the thumb, the surrounding fat should return to its place; using a thin resin twig, several parts of the ham are sticked in order to smell the perfectly-matured ham. The monitoring supervisor could thus detect

a hundred different smells. He is the one who decides when the hams are ready for commercialization. About 30% of these black-labeled hams are sold in Spain, where they are often offered as Christmas gifts (Davet, 2020). The Cinco Jotas company which has become since 1983 the property of the Jerez wine-and-spirit group Osborne, produces only back-labeled Iberian hams. For instance, in Jabugo, the buildings of the company make up one-third of the village area. There, the pigs are slaughtered from January to the end of March. The company masters the whole cycle of ham production, from the piglet stage to the commercialization of more than 400,000 black-labeled hams per year. The company also markets shoulders of the Iberian pig that are matured (cured) like hams, dried and slightly smoked pork loins (*lomos* in Spanish), as well as various kinds of sausages and chorizos (Davet, 2020).

In the 1990s, in France, pioneers such as Philippe Poulachon started to import and sell Iberian hams. In 1995, he launched the brand Bellota-Bellota in about a dozen restaurants and shops. Another pioneer was Jean-François Jeanniot who distributes various Iberian products through La Guildive network; he has been for several years a sales representative of the Cinco-Jotas brand and he promoted, with others, the *pata-negra* hams among French chefs and gourmets (Davet, 2020). Iberian hams are certainly a luxury product, due to the very strict conditions of pig husbandry in the *dehesa* natural ecosystems, but they have been and are still part of the authentic Spanish food habits and lifestyle.

The successful return of desserts

During the 2000s, a new generation of chefs appeared in the media and they were generally awarded prices and Michelin stars; in the 2010s, the same media praised the talents of those chefs who were cake-makers and confectioners. There are many of them in France, where they work either in their own shops or in restaurants, some of those belonging to renowned hotels, e.g. in Paris. At the beginning "these chefs were not so much appreciated by cooks," as recalled by Michel Guérard who became *Meilleur ouvrier de France* (The Best Craftsman in France) in pastry and was then promoted to a full chef, before he established his reputation. It is true that for many years, cake-making or confectionery was the least highlighted part of French gastronomy. Nevertheless, it had established its excellence for centuries. The chef Alain Ducasse keeps underlining: "If the cuisine has become international, patisserie remains French." With almost 30,000 bakeries and patisseries, and 4,000 shops selling cakes, chocolates, confectionery and ice-creams, France has a unique density of this kind of commercial spots. This shows that there is a culture fond of sugar that is closely related to a know-how whose precision and meticulosity need a long training (Davet, 2017a).

Tanguy and Genin (2017) co-authored a book lilted *La merveilleuse histoire des pâtisseries* – The Wonderful Story Of Patisseries. Jacques Genin is one of the best cake and chocolate-makers of his generation, while Michel Tanguy is a renowned chef. Both remind us that in the Middle Ages the so-called *oubloyers* have been given the privilege of making the *oublie* – derived from the Medieval Latin word *oblata*, meaning a religious or ceremonial offering – a kind of sweet wafer, that may highlight

the symbolic nature of ceremonial pastries. Between the 13th century and the end of the 19th century, the significance of *oublie* consumption, which was always part of a ritual, gradually disappeared. Henceforth, its presence in the course of a meal was related only to the sensory pleasure enhanced by a food combining flour, fats and sugar. Nonetheless, it sill remains associated with rejoice, and no feast is complete without it (Bonnain, 1993). During the Renaissance period, the *oubloyers* became *pasticiers* after having been given the right to make sweet and salty patés and pies that were made before by bakers (Davet, 2017a).

Published in 1653, *Le Pâtissier français* (The French Cake-Maker) was the first book devoted to patisserie, that consisted of making both salty and sweet products. The book was probably authored by François Pierre de la Varenne, who wrote earlier, in 1956, the book titled *Cuisinier français* – The French Cook – which became the nickname of F.P. de la Varenne. The latter's logo was "Health, Moderation and Refinement." La Varenne, as commonly named, was born in 1618 in Dijon, centreeast of France, a city famous for its Burgundy red wines; he died in 1678 in the same town. He was employed by the Marquis of Uxelle and he tried to simplify the food recipes, while preserving the taste of food ingredients and making the meals lighter. Several technical culinary words or phrases are attached to La Varenne, who inspired other contemporary cooks. He reduced the excessive amount of spices – the latter were generally used to hide the bad quality of meats and vegetables – and he contributed to restore the taste of foodstuffs in the meals. That was certainly his contribution to lighter and more tasteful meals during the second half of the 17th century: taste restoration was the biomarker of that period, thanks to La Varenne. While making these culinary changes – lighter sauces, replacement of spices by indigenous herbs – he introduced the three-stage meal, which includes entrées (starters), roasted meat (main course) and desserts. With his book devoted to patisserie, he made it clear that this should not be confused with the existing preparations based on salty and sweet dough. Thus, patisserie became a separate job or profession. La Varenne described the cakes that will become later on part of the French gastronomy – such as the *millefeuille* that was improved by another famous French chef, Antonin Carême (see further).

During the 18th century, the techniques and creativity regarding cake- and confectionery-making have progressed in an outstanding way, as well as the sophistication of the shops devoted only to sweets – in 1767, there were 200 chefs specialized in patisserie in Paris. But it was during the 19th century that were laid the bases of the traditional cakes, such as the *savarin*, *éclair*, *saint-honoré*, *moka*, *Genoa bread*, *religieuse*. The French excellence in patisserie and confectionery was on par with the fame of French cuisine, as well as with the sense of pomp and luxury, as defined by Antonin Carême (1784-1833). The latter created this decorative cuisine and remained ten years at the service of Talleyrand – bishop, minister of foreign affairs of Napoleon the First, who had to negotiate the fall of the French First Empire in 1815 at the Vienna Congress. A. Carême was renowned for setting up incredible buffets and he became the mastermind of tiered cakes and pyramids of caramel-covered profiteroles. He authored several reference books, just as did other cooks having a passion for patisserie, like Jules Gouffé (1807-1877) and Pierre Lacan (1836-1902). While they all made surveys, drafted and published thousands of recipes, they became

unique communicators of French expertise. Augustin Escoffier (1846-1935), an icon of the 20th century French gastronomy, was the last renowned chef and patissier (Davet, 2017a).

Gradually, the two specialities evolved into distinct professions. Before the number of patissiers burst out in France during the years 2000-2010, there were very few stars awarded to cake- and confectionery-making. Gaston Lenôtre (1920-2009) became the star of the profession by the end of the 1960s, and he created new cakes such as *opéra*, autumn leaf or *schuss*. Twenty years later, one of his former apprentices, Pierre Hermé, born in Alsace, profoundly changed the norms of patisserie and became the forerunner of the present trend. In 1998, he created with his partner Charles Znati, his own business that bears his name. He was inspired by the fashion weeks when he created a new collection of confectionery or cakes during every season. Pierre Hermé was the scion of four generations of patissiers from Colmar, Alsace. He is also a smart communicator and his concept of "collection" (seasonal exhibition) is applied to the macaroon; he transformed this Parisian traditional cake into a society gadget and thereafter into a global triumph. In 2017, Pierre Hermé owned *ca*. 60 shops across the world and he has trained many patissiers, among them Christophe Michalak, an icon of the "patisserie generation" (Davet, 2017a).

C. Michalak, 48-years old in 2020, has been a patissier chef at the Plaza Athénée, a five-star hotel in Paris, and won the world cup of patisserie in 2005. He created the *Club des Sucrés* (Club of Patissiers) where younger colleagues used to meet and exchange about their profession. He also opened one of the first blogs regarding his profession and organized several television talk-shows. "My aim is to make the patisserie cooler. The cake-chefs have understood that they could express their talents in the same way as the other chefs and cooks," he stated. "There were in fact dozens of patissiers who were surfing on this new wave and brought the French patisserie at the highest level, making it less sweet, lighter and more attractive. C. Michalak who owned two shops and a coffee-house in Paris in 2017, was however the first to acknowledge what they owed to, and learnt from, the chefs and cooks. For instance, many of them underlined that they were acquainted with "the culture of seeking the good products at the right season." Hugues Pouget, who has been for a long time the patissier-chef at the renowned restaurant Guy Savoy in Paris, stated in this respect: "I have been inspired by them – the cooks – when I decided to eliminate all the artificial colouring-ingredients from my cakes." He used in fact plant-derived powders to give the right colours to his creations (Davet, 2017a).

The profession has become very attractive: "In five years, we reached a stage when they were 10 to 20 candidates for one job advertisement," stated Bruno de Monte, director of the renowned professional school Ferrandi. "There are now more candidates in patisserie than in cuisine," he added. It was also remarkable to observe the increase in the number of women involved in the profession: three-quarters of the students are women, when at the beginning of the 2000s almost all of them were men. Claire Heitzler, which became in 2015 the patissier-chef of Ladurée shops, that sell all kinds of macaroons, stated: "Nowadays, women are less afraid of the profession because the working conditions have been improved thanks to the mechanization of some

tasks and the adaptation of the working schedule." Many magazines and books are published on the art of making cakes and some of them are translated in several idioms and even become best-sellers (Davet, 2017a). The success of patisserie may be due to the fact that all kinds of cakes and sweets are associated with childhood, and "during the periods of crisis people often prefer to remain at home and share simple pleasures within the family," analyzed Cyril Lignac, who was the anchor man in a television show, named *Le Meilleur Patissier* (The Best Patissier), and who owned five shops in Paris. "Either we prepare them at home, or we buy them in specialized shops or boutiques, making or eating cakes is a source of comfort. Moreover, cakes are finally affordable luxury goods," he added. Cakes have invaded the Internet and the social networks: there are more and more on-line viewers or users of all digital tools (Davet, 2017a).

It should also be mentioned that the patissiers who work at the five-star (or more) hotels, e.g. in Paris, have the means to innovate and to reach a climax in their creations; they try to respond to their clients' tastes as well as to the way the media welcome the results of their innovations. A pioneer of this approach was Christophe Felder who was working at the famous Hotel de Crillon, in the heart of Paris, and since 1989 he has been successfully trying to improve the culinary traditions within the team of the chef Christian Constant. "At that time, the restaurant had a dessert trolley, and I tried to impose more and more freshness and to give more value to the desserts served on the plates," recalled this former trainee of Pierre Hermé. The success of C. Felder opened the way to C. Michalak and Angela Musa at the Plaza Athénée, to Laurent Jeannin at the Bristol – another luxury hotel in Paris –, Camille Lesecq at the Hotel Meurice, François Perret at the Ritz, etc. The Paris luxury hotels' patissier-chefs became so famous that their wages climbed up and when one of them was transferred to a new position, the subsequent fees were outstanding (Davet, 2017a).

Leading a new wave of patissiers that combine gourmet perfection and a casual approach, Yann Couvreur has opened two boutiques in popular areas of Paris. Some of his friends did the same, with a view to "having a freedom of innovation that is not impeded by decisions made at the hierarchy level." However, even the most fashionable patisserie is not so rewarding in terms of income. C. Michalak stated in this regard: "One should not think that he or she will make a fortune, because of the investments into the necessary tools, the cost of the raw materials and the high wages. This is even more true when one considers that we are dealing with perishable products and the clients' average purchase is rather modest." Maybe a solution to this economic issue would be to export the French know-how and benefit from the fame of the French patisserie. An example of this approach is that of Sébastien Bouillet from Lyon who did not own any boutique in Paris but had five of them in Japan. Another solution is to diversify the business, e.g. making chocolates, confectionery or even salty creations, as was done by Yann Couvreur, C. Michalak or Christophe Adam. All these young and bold chefs admire their mentor, Pierre Hermé, who opened, in collaboration with the cosmetics company l'Occitane, a vast – 1,000 m^2 – shop on the Champs-Elysées avenue, called The 86 Champs. This is a space where one can enjoy many sensorial and gourmet experiences; it includes a patisserie area, a bar, a tea lounge and a restaurant, as well as a dessert bar selling a broad variety of innovative desserts (Davet, 2017a).

A French confectionery icon of global fame

With more than 200,000 flasks of jam sold in luxury groceries (delicatessen) across the world is 2017-2018, Christine Ferber, a 60-year-old woman in 2020, born in Alsace, has become since the end of the 1990s a worldwide icon, "making the best jams in the world," according to Pierre Hermé. She does not miss any annual chocolate show organized in Tokyo, but the "jam fairy" highlights her talent in her family bakery-patisserie-grocery and delicatessen shop, located in the village of Niedermorschwihr, Alsace, where she was born. Her boutique, called *Au Relais des Trois-Épis* (The Three-Ears Inn), is ubicated in a 500-inhabitant village, nestling in the vineyards overlooking the town of Colmar. With her team she makes Alsatian cookies called *bredala*, as well as *berawecka*, dried-and-candied-fruit-filled pastries, with spices, and several other marzipan-filled pastries. "What I like above all in this profession is its diversity," she stated. "One must juggle with a variety of specialties such as patisserie, bakery, confectionery, chocolate and ice-cream making, whose range is broadened with the seasons, the religious festivals and traditions," she added. Her brother is in charge of the administration of the boutique, as well as of the catering activity – including the production of a duck-and-goose liver paté, slightly flavoured with a walnut liquor. A scion of patissiers living in Colmar, Pierre Hermé, whose mother was also born in the same village as Christine Ferber, is one of her childhood friends who moved to Paris; another friend is Claire Heitzler who became the patissier-chef of Ladurée – the macaroon-manufacturing company – and whose parents lived just in front of the *Relais des Trois-Épis*. C. Ferber decided not to leave her village, while at the same time she enjoys a worldwide fame. At the age of 15, she attended a patisserie school in Brussels and won the French cup of young patissiers. She thereafter improved her skills while working under the leadership of Lucien Peltier, a renowned patissier whose shop is located in the 7th district of Paris (Sèvres street). Her father who passed away in 2011 taught her how to prepare a *kouglof* dough, how to be perseverant in doing what others are not developing, and express herself through her proper creations (Davet, 2017b).

As a jam-maker and producer, "she tries to preserve the fruit's substance, texture and shape, as well as its specific taste," she said. The first priority is to find the best fruits, relying on a chain of small gatherers and producers from the Alsatian rich orchards and with whom she has been acquainted for years. Another of her secrets is to cook a small quantity of fruit – no more than 4 kg in copper-made preserving pans – and in two steps – firstly, a slight simmer and thereafter a night of maceration or steeping; this technique enables her to handle the fruits with care and give the impression that they have been picked up just a while ago. Jams made of one fruit species or of a mixture of fruits and scents, are just a delight to taste. "We have tried to do the same, but in fact we cannot compete," stated Christophe Felder, a pioneer of patisseries at luxury hotels who authored many books of recipes. In 2015, Christine Ferber built new workshops at the village entrance, and, after some reluctance, became a queen of the export of jams, without abandoning her craftwoman's talent. She travels a lot across the world and has won a deserved fame, but she will never leave the warmth of her village (Davet, 2017b).

Confectionery and fruits

The art of confectionery is closely associated with the use of several varieties of fruits that are candied and incorporated in several pastries or sweet-and-sour preparations. Let us take the example of *kumquat* which belongs to the Rutaceae family and reaches the size of a shrub bearing small and bright-orange fruits. Its name is derived from the Cantonese word *gam gwat*, which means "golden orange". This small-sized citrus species, which could be eaten entirely (pulp and skin), has become a very fashionable item, fresh or candied. Grown in China since the Antiquity, highly appreciated by the Japanese people, the *kumquat* has been introduced into the Mediterranean Basin in the 17th century. The *kumquat* belongs to the genus *Fortunella* which includes only six species. But it can be hybridized easily with its relatives, and we obtain the delicious *limequat* (lime and *kumquat*), the *yuzuquat* (*yuzu* and *kumquat*) and others *orangequat*. Two varieties of *kumquat* are generally found on the markets: the oval *kumquat*, known as *margarita* or *nagami* – very acid and with a rather thick skin – and the round *kumquat*, or *japonica* or *marumi* – sweeter and with a thinner skin (Labro, 2019a).

In the French department of Pyrénnés-Orientales (Eastern Pyreneans), *kumquat* has been cultivated for more than 25 years: it is one of the citrus species that could be adapted to the region's climate – even though it is susceptible to temperatures below 0°C. The orchard growers say that the round *kumquats* can be eaten when they are mature, without any processing, like candies, while the oval ones are perfect for making jams, confectionery and fruit jellies. But the *kumquat*, raw, blanched or candied, can also brighten salads and be cooked with duck, blue fish – anchovies, mackerels – and scallops. It can give a special scent to seafood, or be mixed with venison and marrow (Labro, 2019a).

Another example is that of the citron tree. The citron, the origins of which are uncertain (Himalaya, India or even Indochina), is the first citrus species that was introduced into the Mediterranean Basin, via the Silk Roads, by the year 300 BC. It has been used in perfumery because of its aromas, which remind those of the cedar tree. When used in cuisine, it is the whitish thick and soft layer of the fruit, called albedo, that is consumed – the pulp of the fruit is almost inexistent. It is the ancestor of the lemon, a hybrid between citron and bitter orange. *Citrus medica* includes many cultivars called: etrog, Amalfi, Corsican, Sicilian or the *digitata* variety, called Budha's hand with long fingers. The citron is part of the Jewish rituals during the feast of Succot – commemoration of the peregrination of the Hebrews through the desert, before reaching the Holy Land. The fruit is ovoid and embossed, and it could weigh up to 3 kg. It is generally used in confectionery to make jams or fruit jellies. It is also highly appreciated in salted meals. For instance, in Paris, in the 8th district, at the Mermoz restaurant, the chef Manon Fleury cuts the fruit in very thin slices and incorporates them into cooked octopus, whereas another chef from Burgundy, Jean-Michel Carrette, installed in the city of Tournus, makes a condiment with citron and black currant that is served with game. Finally, Cédric Casanova, a great connaisseur of Sicilian olive oil, prefers to serve a carpaccio of the fruit with a few drops of olive oil and fennel seeds, with salt or sugar, depending on the guests' wishes (Labro, 2018f).

Some ongoing forward-looking activities

Shortening the distance between producers and consumers: a common goal of many cooks

There seems to be a common ground or goal among many of the chefs who are at the helm of their restaurants: to achieve a consensus between gastronomy and ecology. And this in addition to the remarkable efforts made toward reaching simplicity, authenticity of savours and flavours, without necessarily excluding some recipe sophistication, as well as the esthetics of presenting and serving food. For instance, this common commitment privileges serving and cooking vegetables instead of meat. It also means selecting local producers – farmers, market-gardeners, fishermen, etc. – in order to avoid lengthy transportation of the food and to have fresh produce every day; it also includes reducing wastage of food and recycling kitchens' wastes. In other words, they tend to reduce their carbon footprint on the environment. In this regard, Camille Labro (2018a) recalls that the agriculture and food sector produces almost one-third of greenhouse-effect gases in France (2017 figures) – and this proportion is similar in other developed countries – and she underlines that many restaurant owners and cooks are struggling to support a sustainable, pro-farmer and organic agriculture. They do what they can to reach this objective, e.g. through purchasing homegrown food ingredients and recycling their kitchens' wastes. This trend reinforces the fact that the food sector had grappled with this sensible approach since the beginning of the *locavore* movement. To grow and serve the freshest food is sometimes an expensive undertaking, and the morals, aesthetic preferences and economics do not always play nicely together. This, in turn, usually means that only the very wealthy are able to partake in meals with such rigorous constraints regarding the provenance of ingredients (Rodell, 2019). In the 11 January 2019 issue of *The New York Times International Edition*, Besha Rodell gave some examples of this gastronomic trend, starting with that of Millbrook Winery and its chef, Guy Jeffreys.

Millbrook is on a 300-acre winery of the same name in Jarrahdale, Western Australia, about a 50-minute drive from Perth. The Millbrook's land has been farmed since the 1860s and has been a vineyard since the 1990s, when it was bought by the Fogarty family. It was the first of four wineries owned by the Fogartys, who were producing *ca*. 17% of the wine in Western Australia. Guy Jeffreys took over the kitchen at Millbrook in 2010 and has attracted much attention for his food and the fact that he buys no produce for his restaurant. Almost all of it – fruit, grains, vegetables and herbs – is grown on the grounds by the chef and his kitchen staff. Oil is made from the fruit of olive trees on the property. Meat and fish, bought whole and butchered at Millbrook, come from nearby farms and fisheries. Millbrook serves only lunch. Many dishes have a Mediterranean bent, like shaved rare beef covered with a sauce made from peas, mint and Parmesan cheese. Others seem Californian, like a startingly good plate of avocado and house-made cottage cheese, paired with a toasty, savoury granola. Only the wines might give away the location – the bottles produced here are deeply Australian, all rich chardonnays and fruity shirazes. The pastoral wonder of a meal grown almost entirely on the premises is impressive – so impressive that it is practically impossible. Serving local food is hard and expensive. Therefore, says Besha

Rodell, this type of food production needs a benefactor of some sort, or at least a larger business with a broader aim. The restaurant at Millbrook exists as a marketing arm for the winery, drawing people to the property and raising the profile of the business as a whole. The cost of real estate – and land to grow food ingredients – is not a part of this restaurant's equation, or its prices (Rodell, 2019).

Similar economic arrangements can be found at other restaurants that emphasize homegrown food. The farm that supplies Blue Hill at Stone Barns in New York operates as a non-profit, with a US$300 million endowment from the Rockfeller Foundation. The restaurant at Blackberry Farm in Virginia acts as a draw for its overnight guests who pay up to thousands of dollars each night for meal-inclusive accommodation. Consequently, stated Besha Rodell (2019), you can eat at Millbrook a meal that expresses the specific terroir of this pocket of Western Australia, for as little as 50 Australian dollars; this is something of a miracle. It could not happen at a regular restaurant. It could not happen without a chef and cooks willing to work double duty, in the kitchen and in the field (Rodell, 2019).

There are also several instances of French restaurants who are environment-conscious and who try to bridge economy with gastronomy and ecology. In particular, they buy produce from nearby farmers and recycle their kitchen's wastes. But it is not easy. Camille Labro (2018f) gives the case of a restaurant in the 6th district of Paris, L'Épi Dupin, where the chef Francis Pasteau has been working for 24 years, making a delightful, environment-friendly-and-conscious cuisine. As an ambassador for a sustainable gastronomy, F. Pasteau has co-founded the association *Bon pour le climat* (Good For The Climate) and he is also president of Ethic Ocean, a strong advocate of sustainable fisheries. At the Épi Dupin, the vegetables are the output of organic farming, homegrown and seasonal, while meats are produced by small livestock-breeding farmers; fishes do not belong to species that are under the threat of extinction; and the food ingredients are wholly used (peels, leaves, fish bones). The ratio between vegetables and meats has been reversed, so that vegetables are cooked in the first place. These recipes which are "good for the climate" include: celery, hazelnuts, smoked haddock, creamy leeks, scorpion fish in a crust of buckwheat, steamed vegetables in a coco-curry, roasted weever filets. F. Pasteau is also very careful about the recycling of its kitchen's wastes: they are collected by the French company Moulinot – one of the very few companies that transform food wastes into compost. This company was created in 2013 by Stephan Martinez, also a cook and restaurant owner; it transforms the biowastes of 700 restaurants in the Ile-de-France region, or *ca*. 900 tons per month into compost and energy from incineration (Labro, 2018f).

In addition to several excellent restaurants, school canteens, hospitals, markets and even some McDonald's recycle their kitchens' wastes. But this recycling is costly: for instance €500 per month for a restaurant like l'Épi Dupin. In the case of another restaurant located in the 13th district of Paris, Au Tempero, there is no need for collecting the wastes, because the chef Alessandra Montagne is working directly with the periurban farm at Saint-Denis, north of Paris. She receives vegetables every week and she delivers all her kitchen's biowastes to the market-gardener who transforms them into compost used as a crop fertilizer. The French and Brazilian chef stated: "It is out of the

question for me to use products that come from across the world; it has no interest for the taste and it is a disaster for the environment." Not only she finds the right products from local producers, but the cost of the meals she prepares are reasonable: €15 to €23 per person at lunch time. Regarding Patrice Gelbart and Stephane Camboulive who opened their restaurant at the Théâtre Genevilliers (also in the north of Paris), they are members of the Slow Food Alliance and they are promoting farmers' seeds and vegetables from organic farming, working in connection with the farmers' seed association, Graines del Pais. Their cuisine is at the service of conserving biodiversity. Still in France, but farther south, the chef of an inn, called Auberge Fenière, offers meals that are derived from a direct involvement with the producers and at the right season. Nadia Sammut, the chef, stated: "My primary role is to support, to accompany and value my region's farmers involved in the ecological and energy transition." In her inn, like, in F. Pasteau's or A. Montagne's restaurants, every detail counts: natural textiles, less packaging, no vacuum cooking – which uses plastics –, solid soap and shampoos in her inn's guest rooms, non-corrosive cleaning products. "One has to think about any detail, nothing is perfect, but we are improving every day," she added. She was awarded the label "Outstanding" by the hygiene service, emphasizing that food safety and an ecological mindset are fully compatible (Labro, 2018f).

The case of seafood

Cheng et al. (2020) published an article titled: *Record-setting ocean warmth continued in 2019*. The researchers belonging to the International Center for Climate and Environment Sciences, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, and other institutions from China and the United States, found that the world's oceans – especially the upper 2,000 m – in 2019 were the warmest in recorded human history. Specifically, the ocean heat anomaly was above the 1981-2010 average and also above 2018. The past five years (2015-2019) were the top five warmest years in the ocean historically and the past ten years (2009-2019) were also the top ten years on record. Measuring ocean heat content (OHC) is one of the best ways to quantify the rate of global warming. The OHC values – for the upper 2,000 m – were obtained from the Institute of Atmospheric Physics (IAP, Chinese Academy of Sciences, Beijing), which uses a relatively new method to treat data sparseness and updates in the instruments that have been used to measure ocean temperature.

This fast ocean warning has an important impact on seafood resources. Hence the need to have, like farming resources, an ecological approach to cooking and to designing different bills of fare. For instance, at Angler, a restaurant that opened in September 2018, close to the water on the Embarcadero, the chef Joshua Skenes is redefining the San Francisco fish house with a tightly edited menu. His kitchen which exults in the seafood of the Pacific Coast, also points to the ways in which many Californian restaurants are adapting in the face of environmental concerns, directing diners away from predictable pleasures. J. Skenes opened his first restaurant, Saison, in San Francisco about a decade ago; it went on to win three Michelin stars. He bought the last international seafood he could find on the market, shipping it in from Tokyo like so many other fine-dining chefs, regardless of the cost. But over the last few years, J. Skenes has built relationship with local fishermen and farmers, and now the bulk of

his ingredients come directly from people who work along the California coastline. "I asked fishermen to bring me anything alive, anything sustainable, as long as the quality was really high," he stated. His menu is now a better reflection of his region, though he and his cooks find themselves with the kind of ingredients they might not have picked off an order form: sausage-shaped sea cucumber and translucent bells of moon jellyfish. It helps that jellyfish and sea cucumber taste good, and that blue-prints for preparing them have existed for hundreds of years in global cuisines (Rao, 2019).

The kitchen has learned to dice the raw jellyfish with its clear flavour of the ocean, and serve it simply with a dipping sauce. Cooks separate the sea-cucumber skin form its muscle for cooking, then serve it grilled with Meyer lemon. J. Skenes, who was expected to open a location at Angler in Los Angeles in 2019, does not pass on well-known local seafood when it is available, including crab. The kitchen has served a lot of purple sea urchin, in part because there are tons of purple sea urchin in the water of California – multiplying at an extraordinary rate, invading and decimating kelp forests and threatening the habitats of other marine species. That, and they taste like a sweet and salty custard when puréed and returned to their shells. Petrale sole, once a local mainstay, is a plainly hideous flatfish with both eyes on one side of the body. It has been fished commercially off the California coast since the late 19th century, when steam trawlers competed in deep waters beyond the San Francisco Golden Gate Bridge and flooded the market with bottom-dwelling fish. When stocks of Petrale and other groundfish collapsed, in 2000, after decades of undiscriminated trawling, federal regulations tightened. Several fisherman families collaborated with Nature Conservancy to start the California Groundfish Collective, which shares data among boats to manage the waters more carefully. The Petrale sole is beautiful at Angler, presented on a platter, its delicate, almost jellied fillets firmed up over fire and lacquered with butter sauce at the table (Rao, 2019). Angler's restaurant, overlooking the San Francisco Oakland Bay Bridge is grand, well-lit and expensively designed, with a hunting-lodge feel and deep wine list. James Syhabout, the chef of Commis in nearby Oakland, surprises customers with edible seaweeds, rather than big-ticket fish. Karen Leibowitz and Antony Myint's restaurant, the Perennial, serves farmed sturgeon and trout, raised on vegan feed. These efforts seem small, but they illustrate how cuisine and gastronomy should adapt to a changing environment in the sea and contribute to the necessary modification of our lifestyle, particularly our eating habits, especially regarding seafood (Rao, 2019).

New roles of farmers in being closer to consumers; circular economy

There is nowadays a growing concern about the issue of making *shorter* the trade deals between the two extremes of the food chain. This tradition is indeed quite old and, for instance, the sales by farmers of their produce on the local markets are still highly appreciated by both the producers and their clients; each actor establishes a close relationship during those local markets that take place once or twice a week and they do represent an important source of income for the farmers. Another form of this kind of circular economy is the sale of produce at the farm gate. In France, for instance, it is quite common in the vineyards, with the so-called *Vignerons indépendants* (Independent Wine-Makers) at the forefront. In 2019, among the 6,000 members of

this association 87% of them stated they had a sales cellar on their property. They have been able to create, each one of them, a list of trustworthy clients, and thus they discovered another way to export their production (Girard, 2019a).

Other sectors of farming have followed this model. In France, at the beginning of the 2000s, numerous farmers decided to join efforts in order to advocate for and defend organic farming. To that end, they set up the AMAP (*Association pour le maintien d'une agriculture paysanne* – Association for Upholding Organic Farming), that signs an agreement between a farmer and a group of consumers; this agreement includes the commitment of the client to buy fresh and seasonal produce. The AMAP network has expanded across the whole territory and by the end of 2015 there were 2,000 AMAP outlets. The farmers also decided to build partnerships with a view to opening farmers' shops selling a wide range of products. All these initiatives find also their way to the Internet and platforms have been created so as to link producers and consumers; among these platforms, Amazon is playing a key role. But as stated by Ludovic Méasson-Damery, an organic farmer who delivers fresh produce to enterprises, under the name of Croc'Champs, "what is crucial and reassuring is the human interaction with the client or the consumer, that cannot be replaced by the Net" (Girard, 2019a; Lorga, 2019).

Laurence Girard (2019a) has underlined that the challenge for those farmers who set up their own shop or sale spot, is to get more value from their production and to finally receive a decent income for their work; in a shorter circuit or in a shortened trade deal, the farmer keeps for himself a larger proportion of the profit, even though he continues to sell the produce to wholesale dealers or to the big food-distribution groups. For instance, a milk producer in the French department of Haute-Savoie decided with a dozen of partners to sell their cheese locally. L. Girard has shown that the profit made from this venture was 40% bigger than the profit made through selling the same quantity of cheese to a wholesale dealer. But she also stressed that the move from the farm to the shop is not an easy task: it is time-consuming, because the farmers have to be present on the spot in order to answer the queries of the consumers – e.g. to explain why some kind of cheese or fruit varieties are not present on the stands at certain periods of the year, or to justify some choices of organic or rational farming. In other words, the proximity with the consumer enables the farmer to elaborate on his production techniques and choices, and it helps prevent some simplistic explanations (Girard, 2019a).

The web site called *Magasin de producteurs* (Producers' Shop) has received the visit of 356 subscribers in 2019. Some of these initiatives intend to operate on a larger scale; e.g. *ca*. 40 producers' shops or marketing spots have joined a network under the name of *Les Boutiques paysannes* – The Farmers' Shops. Most of them are located in the region Auvergne-Rhône-Alpes (centreeast of France). Their main purpose is to demonstrate that there should be no middleman or intermediary between the producer and the consumer, so as to warn against any kind of "imitation" of their approach. The perception of these small producers is very good among French people, who are increasingly conscious of the need to know about the provenance of their food and its quality. The large food-distribution networks have understood this concern and

therefore have increased the number of commercial operations that highlight the role of farmers. In a way, they are trying to rebuild the trust with the consumers, even though a larger part of their sales has to do with industrial and intensive farming. However, one should not be surprised by the opening in the cities' neighbourhood of shopping centres by the "so-called producers", that most often are not managed by the producers themselves. For instance, "We see fruit and vegetable merchants who try to play the role of small producers or big brands which show the photograph of a local producer, although the latter's produce represents only 1% of their sales," stated Pascal Rollet, a manager of a sale spot, opened in 2015 thanks to the assistance of agriculture chambers and located just behind a supermarket. P. Rollet, in partnership with his brother, is opening new shops to sell his organic bread and he has built cooperation relationships with three producers' sale spots (Girard, 2019a).

Produce grown using organic-farming practices can often be out of the reach of low-income consumers. But some argue that circular-economy practices can actually democratize the access to healthy food. That is the tenet of Saladorama, which works with six farmers to produce and distribute healthy meals to low-income communities in three Brazilian cities. Saladorama reduced costs by reaching consumers directly, avoiding the "six to eight" intermediaries that often make healthy food prohibitively expensive, said Hamilton Henrique, Saladorama's founder. The company also saved on transportation costs because it produced food within urban areas and delivered it using bicycles. Can this circular economy model, pioneered by these organizations, help fight climate change and warming? According to Ellen MacArthur Foundation, a British charity promoting circular economy, a large-scale food circular economy would help reduce greenhouse-effect gas emissions by 4.3 billion tons of CO_2 a year, the equivalent of taking one billion cars off the road. It makes sense to grow more food near the urban areas because 80% of the world's food will be consumed by cities in 2050, according to the FAO. *Ca*. 40% of the world's cropland already existed in or near cities in 2019. The foundation is working with six major food companies, including Nestlé and Danone, and with three cities – London, New York and São Paulo – to lay the foundations of a "holistically healthy food system," stated Emma Chow, who leads the foundation's Cities and Circular Economy and Food Initiative (Garcia, 2019a).

To sum up, there are many ways to shorten the distance between farmers and consumers; although this approach is a very old one, it has today many facets (Lorga, 2019). It certainly contributes to avoiding long and energy-consuming transport and to decreasing the carbon footprints of farming. It also helps environment-conscious chefs and cooks to behave in the same way. Finally, circular-economy practices can be used to actually democratize the access to healthy food. In the following chapters, we shall see whether some present eating trends aim to both decrease their overall carbon footprint and to nevertheless include an inventive and authentic cuisine.

Plant-based burgers

The Impossible Whopper has been conceived by the young Californian company Impossible Foods and it has been tested in Sweden and the United States since the spring of 2019. By early November 2019, Burger King has advertised the presence

of this burger on its fast-food menu in 25 countries and 2,500 restaurants in Europe; but not yet in France – till mid-November 2019 – where Burger King prefers to lay emphasis on its gourmet-burgers. In the case of Europe, the American fast-food chain relied on the Vegetarian Butcher, a Dutch company purchased by Unilever, that was selling the so-called Rebel-Whopper. Burger King was therefore outpacing its rival McDonald's in this domain – McDonald's was at that time in a marketing-testing stage. By mid-2019, Nestlé has also started to sell its Incredible Burger, another plant burger (Labro, 2019b). The Impossible Whopper is made of 21 ingredients, including genetically modified soy-protein concentrate, coconut oil, sunflower oil and other items most people have never heard of, such as cultured dextrose, soy protein isolate and zinc gluconate. Beyond Meat, one of the major companies competing in the plant-based "meat" business, stated its products are made by layering plant-based fats, binders, fruit and vegetable-based colours and flavours using a process of heating, cooling and pressure to create the fibrous texture of meat (Tugend, 2019). Beyond Meat's burger is made from proteins that come from peas, mung beans and rice, and is laced with beetroot to give the patty a reddish hue and the ability to "bleed" when bitten. It also contains specks of coconut oil and cocoa butter that give the burger a marbling when cooked, akin to the fat in a beef burger (*The Economist*, 2019a).

In 1901, John Harvey Kellogg, the inventor of the cornflakes, was granted a patent for protose, a "vegetable substitute for meat" made of wheat gluten and peanuts (*The Economist*, 2019a). In 1992, the first "VegeBurger" was conceived by Greg Sams, the founder of the macrobiotic restaurant Seed in London. It consisted of a pancake made of wheat proteins, *azuki* beans and oats flakes. Plant-based pancakes have been sold in the organic-food shops for more than thirty years, but the innovation with the new plant burger is that it has a profound similarity with a meat burger. The presence in the Impossible Burger of an additive extracted from soybeans, the leghemoglobin – a red pigment that looks like hemoglobin – gives to the plant burger an aspect, a texture and a savour that are very close to beef (Labro, 2019b). The red pigment can also be produced by genetically modified yeasts, as demonstrated by Patrick Brown, a former biochemistry professor.

Although meatless burgers, chicken nuggets and sausages have existed for years, they have largely been marketed toward vegetarians. This new plant-based meat is aimed at meat eaters as well. "It is clear the American palate has been trained on a diet of animal foods," explained Michele Simon, executive director of the Plant Based Food Association, a trade organization. "For the average person, it will be difficult to trade hamburgers for salad, and new companies are trying to reach the hard-core meat eaters," he added (Tugend, 2019). What makes meat taste like meat? The full sensory experience of eating a slab of meat starts when the constituent proteins, fats and sugars within it interact during cooking. Apply heat and the aminoacids and sugars react. The meat goes brown and releases dozens of volatile molecules that give it its flavour and odour in a process known as the Maillard reaction. Afterwards, as the meat is eaten, the bite, texture, *umami* flavour and melting fats combine to give meat-eaters an experience that they know as "meaty" (*The Economist*, 2019a).

A number of companies are active in making plant-based products. M. Simon commented that her trade association, which started in 2016 with 22 members, had 157 in 2019. But the two major disrupters are Beyond Meat and Impossible Foods. The latter is privately held, but the former went public in May 2019 with the best-performing public option in recent history. Since Beyond Meat went public, its valuation has more than quintupled, to US$8.4 million. It has raised US$700 million in private funds. The backers of these companies include Bill Gates and Richard Branson. They have been supporting such startups that are very innovative in finding and marketing meats or dairy product substitutes. Both companies are looking far past the supermarket aisle to meet consumers where they eat: fast-food outlets. Burger King, KFC, Carl's Jr., White Castle and others are serving burgers and other products made by either Impossible Foods or Beyond Meat. None of these places would be swapping meat for meatless food if it were not good business (Tugend, 2019).

By mid-2017, Impossible Foods' "vegetarian, raw burger" was served in eight restaurants, and the company relied on renowned chefs, such as David Chang at the restaurant Momofuku, New York, and TraciDesJardins, at The Jardinière, San Francisco, to support its product. In the case of TraciDesJardins, he added caramelized onions to the burger and the price was US$16 or €14 per meal in 2017. On 22 March 2017, the successful acceptance of this vegetarian raw burger led to the opening of a new factory in Oakland, California. The output of this factory has been estimated at up to 4 million "steaks" per month and 80 people were to be employed in the plant. The so-called "millennials" (30 to 40-year-old people) would be attracted by the advertised characteristics of this high-tech burger: "no cholesterol, no hormones and no antibiotics"; moreover, they would not be so much scared by any kind of genetic engineering involved in its manufacture (Lesnes, 2017).

The Beyond Famous Star was one of Carl's Jr.'s most successful burger launches of 2017 and 2018, a company spokesman stated. A&W Canada introduced its Beyond Meat Burger during the summer of 2019 and sold out in a matter of weeks, explained Susan Senecal, the company's chief executive officer (Tugend, 2019). A big difference between meat and plant-based products is that the latter are continuously improving. For instance, from the moment Impossible's burger was released, the company began gathering feedback. Consumers told the company they wanted a burger with a better "bite" and they wanted to be able to grill it themselves without it falling apart. Impossible Foods also wanted to reduce the amount of salt and saturated fat while adding more protein. The Impossible Burger "2.0", released in 2019, replaced wheat protein with soybeans, which had the advantage of making the burger gluten-free. Future iterations are planned. Researchers want to make the burgers juicier, so they do not become dry when cooked beyond medium (*The Economist*, 2019a).

Atze Jan van der Groot at the Food Process Engineering Laboratory at Wageningen University, Netherlands, has been working with the Dutch firm Vegetarian Butcher – a pioneer in the plant-meat industry (p. 224). Their invention has been to create muscle-like structures within slabs of plant-based meats using a device called a Couette cell. This consists of two concentric cylinders, one of which rotates around the other while the ingredients are sandwiched in between. By exerting force on the

proteins in the mixture, the ingredients lengthen into fibers and wind around one another. The result is a gelatinous red slab of plant meat that contains long, thick, elastic muscle-like fibers which look and flake apart like pulled pork or beef. Van der Groot's team has shown that when grilled, cuts from this "muscle" can sizzle, brown and give off aromas like a steak (*The Economist*, 2019a).

Smaller firms that specialize in ingredients for plant-based food have started to spring up, and more established ones, such as Ingredism are moving into this space too. Its researchers are investigating whether other crops, such as yellow peas and fava beans, can make good meatless meat. In 2019, Motif Ingredients, a startup created by Ginkgo Bioworks, a biotechnology firm in Boston, raised US$90 million to develop specialized ingredients for plant-based products. Jon McIntyre, Motif's boss, aims to make flavourings and other additives to improve texture a bite say, by inserting specific DNA sequences into the genomes of yeast. Fermenting that yeast will then produce the desired products (*The Economist*, 2019a). Big food producers are getting involved in the funding of research and development. Kraft, an American firm, funds an incubator that invests in "disruptive" food brands. Unilever bought Vegetarian Butcher in 2018 for an undisclosed amount. When it comes to R&D, Niko Koffeman, one of the founders of Vegetarian Butcher, said Unilever will invest as much as is needed to make the company the "world's biggest butcher." None of these developments has escaped the attention of traditional meat packers. Tyson Foods, a large meat processor based in Arkansas, was an early investor in Beyond Meat. In June 2019, it joined the fray more directly, launching a range of plant-based "chicken" nuggets and "blended" burgers, made with both plants and animal meat, which it claimed were healthier than the traditional kind (*The Economist*, 2019a).

Some of these companies looked also to plant-based milks as a precedent. The market for these took off in the mid-2001, recalled Matt Ball from the Good Food Institute (GFI), a non-profit group in Washington, D.C., that monitors and promotes awareness of plant-based meat. That owes something to canny marketing. In 2002, Dean Foods bought Silk, a soya-milk brand, and insisted that it was placed next to cow's milk in supermarket shelves. That made consumers think of it as another variety of the milk they put on cereals, rather than a weird product for people with allergies. In 2018, plant-based milk – including almond, oat and hemp – accounted for about 15% of retail milk sales in the United States and 8% in the United Kingdom. During 2018, nearly two-fifths of American households bought alternative milks. Often they did so alongside dairy products; in a poll by Ipsos-Mori 38% of American consumers stated that they drank plant-based milks, but only 12% did so exclusively. The others were flexitarians, drinking both milk and the nutty or bean variety. In the United Kingdom, 20% of people surveyed by Mintel drank such products, but only a third of those did so because of an allergy or intolerance. The rest said the new milks were healthier or more ethical (*The Economist*, 2019a).

Regarding the price of these plant burgers, analysts at Bernstein, a research firm, reported that a Beyond Meat burger retailed at US$11.50 per pound in supermarkets, compared with US$7 to US$9 for posh meat patties (2019). On 20 September 2019, Impossible Foods burgers made their debut in the United States' supermarkets, retailing for *ca*. US$12 per pound. But competition should lower their prices. For its

part, Beyond Meat hopes that as it ramps up production, prices will fall. Peas, the main source of protein used in its burgers, are in plentiful supply worldwide, but getting them from the field to the plate has been tricky. The protein is extracted by firms such as Puris or Roquette and then transformed into burgers by Beyond Meat. In 2018, bottlenecks in the pea-protein supply delayed the firm's launch in Europe. Limited production capacity prompted it to fly patties to Europe from its only plant in the United States. Only more recently, production capacity has risen to meet demand. Beyond Meat's new Dutch plant will help. Puris has teamed up with Cargill – one of the world's biggest four grain traders – to expand its capacity. Roquette was investing €500 million to do the same (*The Economist*, 2019a).

In 2019-2020, the market for meat substitutes was tiny. Euromonitor, a market-research firm, estimated that Americans spent US$1.4 billion a year on them, around 4% of what they spent on red meat. Europeans also chomped through *ca*. US$1.5 billion-worth of meatless meat a year, but this was 9% to 12% of what they spent on animal flesh. Analysts at Barclays Bank estimated that global sales of alternative meats could grow from 1% of total market for meat to 10% over the next decade. According to a prospect made by JP Morgan, another bank, the market of meatless products would reach a value of up to US$100 billion by 2035 (Labro, 2019b; *The Economist*, 2019a). Nearly two-fifths of Americans who described themselves as carnivores told a survey by Mintel in February 2019 that they wanted to add more plant-based foods to their diet. Some call themselves "flexitarians", not vegetarians or vegans, but anxious to reduce their meat consumption nonetheless. Young people are the most fervently flexible. *Ca*. a third of those under the age of 35 in the United Kingdom told a poll by Mintel in September 2018 that they wanted to cut the amount of meat they eat, compared with less than a fifth of older people. Partly because of this, demand for meat substitutes has grown by 37% in the United States during 2017-2018 and by 30% in Western Europe (*The Economist*, 2019a). But is plant-based burger (meat) healthy? It is typically as healthy as eating unprocessed vegetables and beans, and if it is produced for fast-food outlets, it can be downright unhealthy. For the sake of comparison, the plant-based Beyond Famous Star burger with cheese at Carl's Jr.'s brings in 710 kcal, and contains 40 g of fats and 30 g of protein, while the Famous Star burger with cheese provides 670 kcal, and contains 37 g of fats and 28 g of protein (Tugend, 2019).

The high-tech burger

Research and development

On 5 August 2013, at Riverside Studios in London, took place the first public eating and tasting of an artificial burger, produced in the laboratory. Facing a number of journalists, the majority of them being Anglo-Saxon, Richard McGeown, a renowned chef that had worked with Gordan Ramsay, cooked in a panhandle with a small quantity of butter and sunflower oil a piece of "ground meat" weighing 142 g. This steak was served to two tasting-persons who had been selected by the organizers: Josh Schonwald, the American author of *The Taste OF Tomorrow* (2012), and Hanni Rützler, an Austrian nutritionist. Chicago journalist J. Schonwald's quest to taste the food of tomorrow took him across the globe, from Alice Water's Northern California micro-farm to the Dutch laboratory that pioneered "meat growing". *The Taste OF Tomorrow* takes

the conversation about food and sustainability a step further, and exploring the wild possibilities that science is making possible today, J. Schonwald and H. Rützler concluded that the taste of the meat was "almost" the same as a normal hamburger[1]. According to the *Washington Post*, present on the place of the experience, "not anyone of both tasters rejected the meat and were not afraid of eating it." The only comments made were: Hanni Rützler stated that "the artificial meat was not as juicy as meat," whereas Josh Schonwald thought that artificial meat "lacked a little fat." The test was therefore satisfactory for this 142-g hamburger the cost of which amounted to €250,000 or US€330,000.

Three years earlier, Mark Post, the Dutch scientist working at Maastricht University manufactured this artificial meat in the laboratory and he explained why this public tasting was necessary: "The technology has been available for *ca*. 15 years and is rather close to that of repairing cellular lesions." To make this *in-vitro* meat, his research team has taken a sample of stem cells in the muscle of a cow's shoulder. These cells were grown in a "culture medium", containing amino-acids, sugar, growth factors, hormones and calf's fetal serum; they were able to give rise to muscular minifibers, that were later on assembled in the final burger. About 20,000 of them were necessary to make the high-tech burger tasted in London. This burger needed only eight to nine weeks to be made; it is not in fact meat, because it is deprived of fat, blood vessels and nerves. Its colour is pale and not appetizing, but it can be coloured with beetroot juice and saffron (Géné, 2016c).

This research programme which started in 2005 and was funded by public money and also by Sergey Brin, the co-founder of Google, was justified by the following statements: "We think that global meat consumption is increasing steadily. Not so much in the Western countries where it is nowadays relatively high, but in those countries where its consumption is low or whose populations have adopted a vegetarian diet. In the present conditions, it would not be possible to increase the offer in order to meet a demand that would probably overcome the limits of production. Also an increase in the production of red meat would result in the increase of greenhouse-effect gases and its subsequent environmental changes. Finally, even though the issue of animal well-being is increasingly present in the mindset of a large public, we think that it would not make sense that we might be able to convert the world's population into a vegetarian one in the near future. For all these reasons, we must find an alternative." Would therefore artificial meat be that alternative? Mark Post seemed to be rather optimistic in this regard: even though the initial product was not perfect, its improvement from the "technical" viewpoint – e.g. introduction of fat and modification of texture – is in the purview of Mark Post's team. The main drawback was to cut the cost of the final product before commercializing it. "The calculations made by M. Post indicate that it would be possible to lower the cost down to US$10 the burger in five years, which is still expensive; but in the two or three following years, a much lower price could be reached before the commercialization of the product in supermarkets," added M. Post (Géné, 2016c).

1- The word hamburger is derived from Hamburg, the German and Hanseatic town. Originally a piece of beef was called Hamburg stuck, converted into Hamburg steak in the United States, and thereafter to hamburger (ground meat).

By contrast to several soybean-, or pea- and plant-component-based burgers, that are already available in some supermarkets and restaurants in the United States, the so-called "clean meat" or "pure meat" is made of real animal proteins. In Europe, the companies involved in research-and-development of this new kind of meat prefer to name it "cellular meat" or "cultivated meat". Those who are opponents of this high-tech burger call it "*in-vitro* meat" or "laboratory-made meat." American food regulation authorities have not yet made a final decision on how to name this kind of meat as well as on the labeling of the products derived from this "cell agriculture". What is at stake is how they will be commercialized, e.g. under the name of "meat" or simply "animal proteins" (Gérard, 2019a). Meat makers are lobbying for protection. Terrified of the prospect of meat grown from stem cells in laboratories, the beef industry in the United States has been urging legislators to restrict the use of the word "meat" to that which comes from an animal carcass. At least nine American States – including Arkansas, Missouri and Mississipi – have agreed. The National Cattleman's Beef Association is also asking the US Food and Drug Administration (FDA) to outlaw what it sees as misleading labeling of *in-vitro* meat. In April 2019, the European Parliament's Agriculture Committee recommended the introduction of a ban on using such terms as "burgers" and "sausages", although the proposal has not been voted upon by the full parliament. The European Court of Justice ruled that many meat alternatives could not be labeled "milk" in 2017, but this did not noticeably affect demand. *The Economist* (2019a) is of the opinion that the word "meat" may one day simply evoke the sensory experience that comes from eating a particular blend of fats, aminoacids, minerals and water.

Producing this kind of artificial meat is supported by private investors, interested in new technologies, such as Sergey Brin, who contributed US$250,000 to the initial production of the high-tech burger. There is already a rather strong competition in this area, because investors believe in this technology and its social acceptance. In 2019, *ca*. 30 high-tech startups, mainly ubicated in the Silicon Valley, California, but also in Europe and Israel, were involved in the production of ground meat ("tartare" steak), meat balls, chicken nuggets, sausages and even fish fillets, from animal stem cells. For instance, in February 2016, Memphis Meat, a startup in San Francisco, commercialized its first meat balls made of artificial meat at the price of €16,080 a pound. According to this startup's director Uma Valeti – a former cardiologist – the company intends to commercialize its sausages, burgers and balls at competitive prices in 2021. Memphis Meat was supported by SOS Venture, which already funds Netflix and Guitar Hero; and also by the Bill and Melinda Gates Foundation and other partners in the Silicon Valley (Géné, 2016c). In the Netherlands, the company Mosa Meat, founded by Mark Post, is making an important endeavour in order to drastically cut its costs of production, with a view to selling its artificial steak at US$10 a piece, according to Sarah Lucas, chief of operations at Mosa Meat. She hoped to commercialize this ground steak in 2021 and, firstly, in a few partner restaurants (Gérard, 2019a).

Clean or *in-vitro* meat social acceptance

The supporters of clean or *in-vitro* meat think that this "cellular agriculture" is a more sustainable alternative to livestock husbandry, especially in the context of the world's

population growth increase – reaching 9 to 10 billion people in 2050 – and the rise in global meat consumption. The high-tech burger may become an easily traceable meat, of which the production would need less water and soils, as well as no inputs of fertilizers and pesticides (see further). In addition, it may provide a better food safety because it is produced in a sterile environment. According to a study carried out by Lux Research, quoted by the *San Francisco Chronicle*, the demand for meat alternatives would double during the next seven years. According to Patrick Brown, the founder of Impossible Foods, "compared with beef burger, the production of high-tech burger uses 74% less water, 95% less land acreage and its manufacture produces 87% less greenhouse-effect gases; which means that it contributes to a more sustainable food diet on Earth" (Lesnes, 2017; see further).

In Tel Aviv, the company Supermeat, founded by Yaakov Nahmias, a professor of nutrition, is working on chicken and in 2016 it has tried to raise funds in order to manufacture an artificial chicken meat thanks to stem cells contained in capsules similar to those used to make expresso coffee; it was expected to design an operational prototype in 2019. Memphis Meat's boss was very enthusiastic about the future prospects of artificial meats, when he stated: "We are going to achieve a revolution in the meat industry in the same way when motor-cars replaced horse-drawn carriages." But consumers will have to be convinced: social acceptance is the main challenge (Géné, 2016c). However, Didier Toubia, a French agronomist, who is the chief executive officer of the Israeli startup, Aleph Farms, located in Tel Aviv, was more careful: "The *in-vitro* meat is not meant to replace livestock husbandry, it is an interesting solution among others." Aleph Farms is manufacturing pieces of meat muscles, at a price of *ca*. €50 per piece, while the majority of the companies involved in this sector try to produce ground meat. But whatever the goal of artificial-meat production, it raises controversial debates. And firstly about the techniques used to culture stem cells. The first prototypes have used a culture medium containing fetal serum. The latter is usually part of the medium where cells are grown for medical purposes; it is withdrawn from the blood of bovine fetus, after the slaughter of pregnant cows; this kind of extraction is condemned by the opponents of this procedure. The startups involved in artificial-meat production are perfectly aware of this opposition. "We should be able to demonstrate that our product does not provoke any animal suffering," agreed Sarah Lucas of Mosa Meat. In fact, research is being carried out on plant substitutes of fetal serum at Mosa Meat and Aleph Farms companies (Gérard, 2019a).

Also in designing the culture medium of stem cells, the company Finless Foods, that produces red tuna fish from cell cultures, is relying on genetic engineering. It stated that the genetically-engineered proteins only serve to support the growth of cells and that they are not present in the final product. But the issue of genetic-engineering processes is a controversial one. That is why Mosa Meat stated: "The cells we grow should behave in the same way as they do in living animals. There is therefore no reason to rely on genetic engineering." Mosa Meat explained that some of its competitors may be tempted to do so because genetic engineering may cut the production costs. In 2015, a group of researchers including Jean-François Hocquette, a research director at the French National Agricultural Research Institute (INRA, Unit on Herbivore Research), and belonging to France Business School, Clermont-Ferrand,

Clermont University Polytech, and the School of Veterinary and Life Sciences, Murdoch University, Murdoch, Western Australia, have carried a poll to understand how educated consumers believe if artificial meat could be a solution to the problems of meat industry (Hocquette et al., and J.-F. Hocquette, 2015). According to artificial-meat promoters, the latter has a potential to make eating animals unnecessary, to reduce carbon footprint of meat production and to meet all the nutritional needs and desires of consumers and citizens. To check these assumptions, a total of 817 educated people (mainly scientists and students) were interviewed worldwide by internet in addition to 865 French educated people. The researchers also interviewed 208 persons (mainly scientists) after an oral presentation regarding artificial meat. More than half of the respondents believed that "artificial meat" was feasible and realistic.

However, there was no majority to believe that artificial meat will be healthy and tasty, except respondents who were in favour of artificial meat. The vast majority of consumers wished to continue to eat meat even though they would accept to consume less meat in a context of increasing food needs. Only a minority of respondents (from 5% to 11%) would recommend or accept to eat *in-vitro* meat instead of meat produced from farm animals. Despite these limitations, 8% to 47% of the respondents would continue to support research on artificial meat, but a majority of them believed that artificial meat will not be accepted by consumers in the future, except by those in favour of artificial meat. The researchers speculated that the apparent contradictory answers to this survey expressed, on the one hand, the fact that people trust scientists, who are able to discover new technologies potentially useful in the long term; on the other hand, respondents also expressed some concerns regarding their health; they argue that artificial meat will not be tasty, safe and healthy enough to be accepted by the large majority of consumers (Hocquette et al., and J.-F. Hocquette, 2015).

In October 2016, Jean-François Hocquette published another article titled: "Is *in vitro* meat the solution for the future?" He indicated that the majority of experts consider that there are still numerous technological obstacles that have to be overcome in order to produce *in-vitro* meat. In addition, even though *in-vitro* meat could eliminate the supposed lack of well-being of livestock and has the potential to free up cultivable land, other supposed advantages are questionable and not always agreed upon by the scientific community. Another major problem for the commercialization of *in-vitro* meat would be its acceptance by consumers, even though some consumers are ready to taste it at least once. The consumption of *in-vitro* meat will depend on a conflict of values at an individual or collective level. The reality is that there is a range of other complementary solutions which meet the challenges of food supply in our society (Hocquette, 2016).

Later on, J.-F. Hocquette (2016, 2017) elaborated on the issue regarding the reality or utopia of artificial meat. He explained that the international scientific community was more skeptical than the media about the future of commercializing *in-vitro* meat. In both articles, he referred to the explanations given in the 2015 article published with several colleagues, and he mentioned various approaches to feeding the world. In the first place, the drastic reduction of food wastage (one-third of the food produced worldwide is wasted); secondly, overfeeding should be avoided by well-off

consumers and the increase in the consumption of plant proteins should be promoted in people's menus, without nevertheless completely eliminating meat (but reducing its intake). There are in fact many good sources of plant proteins such as legumes, whole cereals and *tofu*. Other kinds of meats, instead of red meat, could be tested, although they may face social-acceptance problems. Finally, other environment-friendly livestock-husbandry initiatives could be promoted as well as a more efficient way of producing meat products – genetic selection of animal breeds and economics of scale.

Still regarding the social acceptance of *in-vitro* meat production and its future prospects, Paul Shapiro (2018) authored the book *Clean Meat* : *How Growing Meat Without Animals Will Revolutionize Dinner And The World*, published with a preface by the Israeli historian Yuval Noah Harari. The American author described the likelihood of a long-term future when everybody could grow his or her own meat in the family kitchen, using mini-incubators, like some people brew their own beer nowadays. Following the publication of the French translation of his book in March 2019, he was interviewed by two journalists of the French daily newspaper *Le Monde*. He seized this opportunity to state that there is now an alternative to conventional intensive livestock husbandry, which could lead to a similar output (meat) at a lesser environmental footprint or cost. This might be one of the leading technologies that could save us. He explained furthermore that he wrote his book to describe one possible solution, but it was not the only one; due to the very serious situation the world is facing, all other solutions should be put on the table – e.g. reduce the consumption of meat, but also value its plant-derived substitutes, made from peas or soybeans, as well as artificial meat derived from animal-cell cultures. Most of our food is not natural *per se*. When one realizes to what extent our present production methods are not sustainable and not natural, producing meat without animals does not seem so artificial. P. Shapiro finally added that if we propose to the consumers a safe product with the same nutritional and savouring properties as meat, at the same price, and without a negative impact on the environment, many people would be willing to move in that direction. In this context, it is worth mentioning the example of the French startup, called Suprême, that initiated in the fall of 2018 a project named "foie gras that does not kill the duck." This startup has been incubated at Evry Génopole (Essonne department) and it intends to work hand in hand with the farmers. "Livestock breeders know their animals, they are the most qualified to select the best duck to lay the eggs from which stem cells would be sampled," explained Nicolas Morin-Forest, one of the founders of that startup. The objectives of the latter would be to: obtain a foie gras that would be as tasteful as the conventionally-produced one; supply it at an equivalent price; and distribute it on a large scale (Gérard, 2019a).

But is social acceptance warranted? Didier Toubia, the CEO of Aleph Farms, believes so: "The urban consumers who consume meat nowadays, disconnect the beef they buy from its processing and the slaughter of the animal." This so-called cognitive dissonance is being studied by several researchers. Thus, Florence Burgat, (2017; see p. 152), a French philosopher, distinguishes "those who eat flesh and who do not want to be reminded that they are eating an animal, and those who eat animals and are conscious of what they are doing." She went on to mention all the livestock animals "that are saturated with chemicals, are derived from artificial insemination and are

genetically selected breeds," and she is therefore surprised that livestock breeding "is still considered to belong to nature" by contrast to the production of *in-vitro* meat. Didier Toubia insists on the fact that "we have lost the relationship with the animal because we have to meet an increasing demand of meat; and that *in-vitro* meat might help to re-establish trust in meat." In other words, the startups involved in the production of "clean meat" should be able to meet the following challenges: food safety, environmental protection, animal well-being, transparency and traceability. And in addition, they would be able to convince the consumers that their products have the right savour (Gérard, 2019a).

All these viewpoints are strongly rejected by the harsh opponents of artificial-meat production. For instance, the British Ruth Harrison in *Animal Machines*: *The New Factory Farming Industry* (2013), and Aflred Kastler, Michel Damien and Jean-Claude Nouet – *Le grand massacre* (The Great Massacre, 1981) – have denounced many years ago, the industrial violence against domestic animals. But now there are those who consider "clean meat as a poison," like Jocelyne Porcher, (2011; see p. 156), a French social scientist and zootechnician. "Clean meat is a food poison because its manufacture is as opaque as that of the products derived from the agrifood industry. A social poison because its *in-vitro* production increases our enslavement towards the GAFAM (Google, Apple, Facebook, Amazon and Microsoft). An environmental poison because its production is likely to produce the same quantities of CO_2 as the industrial production of meat. An intellectual poison because many politicians and academics, due to their ignorance of the real work with animals, fell into the trap of a simplistic and Manichean thought: they object to animals' death on behalf of the "good" and they are led to make their life irrelevant." To sum up, the controversial debate about the social acceptance of artificial or *in-vitro* produced meat is far from over. It is difficult for the time being to reconcile the harsh opponents of this mode of meat production with those who clearly support it. Which are those societies or communities that would culturally step forward and accept this alternative way of meat production, that is furthermore considered environment friendly? But what is therefore the real environmental impact of clean-meat production?

Environmental impact of clean-meat production

The impact of conventional livestock husbandry on climate change is largely documented. Thus the FAO has calculated that this sector produced *ca*. 7 billion tons of CO_2 per year, i.e. 14.5% of the global emissions of greenhouse-effect gases due to human activities. Methane produced by ruminants' belching (bovine breeds, goats and sheep) plays a prominent role in these emissions. Also the calculation made by the FAO includes the conversion of forests into rangelands and pastures, as well as the production and transportation of feed. "In order to limit global warming under the threshold of 1.5°C by the end of the 21st century, the Intergovernmental Group of Experts on Climate Change (IGEC) has recommended that the emissions of greenhouse-effect gases by the agricultural sector be cut by 50% by 2030," recalled Didier Hauglustaine, a climatologist and director of research at the French National Scientific Research Centre (CNRS, French acronym). To reach that target, Springmann at al. (2018) recommended that beef consumption be cut by 80% by 2050 across the world, that of pork by 88%,

that of lamb by 70% and that of poultry by 50%. Jean-François Hocquette explained that a cow grazing on a pasture produces more greenhouse-effect gases per kg of beef than a cow in an intensive feedlot. However, the sequestration of carbon by the permanent pastures mitigates this difference between intensive and extensive livestock husbandry. "When the soil is not disturbed, permanent pastures can reduce by 30% to 50% the environmental impact of greenhouse-effect gases due to livestock husbandry," explained J.-F. Hocquette (2017).

There is no doubt that moving away from livestock and poultry would reduce greenhouse-effect gases, although estimates vary. In a much-cited report commissioned by Beyond Meat and conducted by the Center for Sustainable Systems at the University of Michigan (Ann Arbor), Martin C. Heller, senior research specialist, and Gregory A. Keoleian, professor and director of this center carried out a "cradle-to-distribution" life cycle assessment of the Beyond Meat Burger or Beyond Burger – a plant-based patty designed to look, cook and taste like fresh ground beef. The purpose of the study was to compare environmental impacts – chosen here as greenhouse-effect gas emissions, cumulative energy demand (energy use), water use and land use – with those from typical beef production in the United States (Heller and Keoleian, 2018). A secondary purpose was to highlight opportunities for improving the environmental performance of the Beyond Burger product chain and provide Beyond Meat with a benchmark against which improvement efforts can be measured. The primary audiences were both internal stakeholders at Beyond Meat as well as external customers, consumers, and interested stakeholders. A critical review of the study, commissioned by Beyond Meat (Savage River, Los Angeles, California), was carried out by Roland Geyer, professor, University of California, Santa Barbara (chair), Alissa Kendall, professor, University of California, Davis, and H. Scott Matthews, professor, Carnegie Mellon University, Pittsburgh, Pennsylvania.

The Beyond Burger is considered functionally and nutritionally similar to beef; therefore the chosen functional unit for comparison was defined as *4 oz*. (*quarter pound, 0.113 kg*) *uncooked burger patty delivered to retail outlets*. This is the marketed patty size of the Beyond Burger and a standard consumer product size of beef patties. System boundaries included upstream ingredient and raw material supply (including farm production of agricultural crops), processing and packaging operations, cold storage, distribution to point of sale, and disposal of packaging materials. Retail and consumer stages, including potential losses at those stages, were excluded, as they were considered equivalent in both product systems. The overall conclusion of the study was that based on a comparative assessment of the current Beyond Burger production system with the 2017 beef life cycle assessment, the Beyond Burger generated 90% less greenhouse-effect gas emissions, required 46% less energy, has > 99% less impact on water scarcity and 93% less impact on land use than a ¼ pound of United States beef (Heller and Keoleian, 2018). However, Ricardo San Martin, research director and industry fellow for the Alternative Meats Lab at the University of California, Berkeley, stated he would like to see more independent information about how the factories that process plant-based meat affect the environment in order to have a full picture (Tugend, 2019).

To have an impact, in terms of climate change, plant-based meat would have to become a staple across the world, replacing beef, goat, pork and chicken. "Unfortunately, the consumption of meat is still increasing worldwide" (although it is decreasing to some extent in developed countries), stated Michael Siegrist, a professor at ETH Zurich's Institute for Environmental Decisions. "The type of plant protein is certainly welcome, but we are, in my view far away from having an environmental impact." However the companies that make these products are optimistic and state they are on the brink of a worldwide growth. Patrick Brown, founder of Impossible Foods, said his company's long-term plan is "to produce a full range of meats and dairy products for every region in the world to completely replace the need for animals in the food system" (Tugend, 2019).

Some research findings are encouraging. "The main message is very clear – plant-based burgers represent very large, often ten-fold, savings in the environmental burdens of food consumption," stated Ron Milo, a biologist who studies sustainability at the Weizmann Institute of Science in Israel. "These savings are true for greenhouse-effect emissions, land use and water use" (*The Economist*, 2019a). However, John Lynch and Raymond Pierrehumbert (2019) of the Atmospheric, Oceanic and Planetary Physics, Department of Physics, University of Oxford, Oxford, United Kingdom, presented a rigorous comparison of the potential climate impacts of cultured meat and cattle production. Warming impacts are evaluated using a simple climate model that simulates the different behaviours of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), rather than relying on carbon dioxide equivalent (CO_2eq) metrics. The researchers compared the temperature impact of beef cattle and cultured meat production at all times to 1,000 years in the future, using four synthetic meat greenhouse-effect gas-emission footprints (GHG) currently available in the literature and three different beef production systems studied in an earlier climate modelling paper. Cattle systems were associated with the production of all three GHGs above, including significant emissions of CH_4, whereas culture meat emissions are almost entirely CO_2 from energy generation. Under continuous high global consumption, cultured meat results in less warning than cattle initially, but this gaps narrows in the long term and in some cases cattle production causes less warming, as CH_4 emissions do not accumulate, unlike CO_2. Then, the researchers modelled a decline in meat consumption to more sustainable levels following high consumption, and they showed that although cattle systems generally result in greater peak warming than cultured meat, the warming effect declined and stabilized under the new emission rates of cattle systems, while the CO_2 based warming from cultured meat persisted and accumulated even under reduced consumption, again overtaking cattle production in some scenarios. Lynch and Pierrehumbert (2019) concluded that cultured meat was not *prima facie* climatically superior to cattle; its relative impact instead depended on the availability of decarbonized energy and the specific production systems that were realized.

But whatever could be the appeal of cultured meat to the young, the urban and wealthy, to make a difference to the planet, meatless meat needs to be on billions of plates, not just millions. In 2017-2018, both Beyond Meat and Impossible Foods have worked with chains such as Burger King, Dunkin' and Kentucky Fried Chicken, making sure that their

brands feature prominently on menus. The Impossible Burger is also served in the British Airways first-class lounge in New York; the Beyond Meat Burger, in business class on some Virgin Atlantic flights. Hoping to mimic the success of plant-based milks, Beyond Meat insisted that its products be placed in the same refrigerated aisles in supermarkets as its animal-based competitors – a condition that Whole Foods, a supermarket chain, acceded to in the United States in 2016. Sainsbury's, a British supermarket chain, now stocks plant-based meat in the meat aisle (*The Economist*, 2019a).

Eating insects, a renewable source of protein

It is estimated that more than 2 billion people across one hundred countries of Asia, Africa and Latin America consume a few species of *ca*. 2,000 insects, that are rich in proteins. For instance, in Japan, China and South Korea silkworm chrysalises are fried or consumed as preserves. Japanese people like to eat cookies containing wasps, while in La Réunion island wasp larvae are eaten fried. In Laos, grasshoppers are fried, water scorpions are boiled, while some spider species are toasted. Giant water bugs are mashed and ground into a powder used to prepare a sauce called *nam prik mang da*. In Cambodia and Thailand, insects (crawling or flying) are grilled or steamed. Australian Aborigens are very fond of ants ("honey flasks") and parasitic caterpillars. In New Caledonia, a festival takes place every year to celebrate the Bancoule worm, that is eaten after having been soaked in grated coconut for few days. In Mexico, "Mexican caviar" is served as a snack and consists of water-bug eggs, or butterfly caterpillars crushed with ant eggs soaked in a garlic sauce. Some restaurants serve such specialty meals as tortillas (maize pancakes) with grasshoppers, or agave (century plant) rootworms. Termites and caterpillars are often present in African peoples' diets. For instance, in Central Africa, the Mandja consume termites, while in Zambia caterpillars are the main source of protein for some ethnical groups. In the suburbs of Johannesburg, it is not unusual to find bags of dried caterpillars or preserved with tomato sauce. In Madagascar, the larvae of a local wasp are cooked in butter with garlic and coriander (Géné, 2016b).

In terms of nutrition, the protein content in an insect could be as high as 70% (40% in locusts); with 10 kg of feed, it is possible to produce *ca*. 5 kg of insects, compared with less than 1 kg of beef, *ca*. 2 kg of pork and *ca*. 5 kg of poultry. Furthermore, insect production is a low-polluting activity as it produces 10 to 100 times less greenhouse-effect gases than intensive livestock husbandry. That is why the FAO has been encouraging for many years research-and-development activities on entomoculture (Géné, 2016b). For instance, Nathalie Picard (2019) has mentioned the culture of the black soldier fly (*Hermetia illucens*), native from tropical America, but nowadays found across all continents. It is grown at the French Insect Biology Research Institute (IRBI, French acronym for *Institut de recherche sur la biologie de l'insecte*) ubicated in Tours (centrewest of France). The larvae of this fly are fed on a mixture of wheat, maize flour and alfalfa; after five days, the larvae reach a size of 5-mm length, and they continue to grow in this solid-culture medium, amidst their own faeces. After two weeks and several metamorphoses, they reach the size of 2.5-cm-brown-and-plump insects that can be harvested. The objective of this project launched in 2017 by the startup Biomimetic, ubicated in Avignon (southeast of France), was to optimize

the culture of this fly, fed with plant residues – such as ground apples, cereal dusts and altered grains derived from the agroindustry –, with a view to producing feed and fertilizers. The black soldier fly, *Hermetia illucens*, as well as the mealworm (*Tenebrio molitor*), are "very efficient in bioconverting organic wastes," according to the FAO and the Research Laboratory of Entomology, Wageningen University, the Netherlands.

A. van Huis (2018) of Wageningen University and the Research Laboratory of Entomology delivered a keynote address to the 2nd International Conference "Insects to Feed the World" (IFW 2018, Wuhan, China, 15-18 May 2018) on the topic "Insects for food, feed and health: a global perspective". He indicated that during the last ten years there has been a growing interest worldwide to use insects as food, feed or pharma. This was exemplified by the increasing number of startups, the emergence of some large international companies, the willingness to invest in this sector, the legislation becoming gradually more conducive and the growing public and academic interest. Insects both as food and feed can be considered a viable and sustainable alternative to livestock and animal-protein production, while contributing to a circular economy by transforming low-value organic side streams in high-value protein products. However, it requires the development of new value chains, and attention to issues such as production costs, food safety, scalability and consumer acceptance. The feed industry in particular requires large supplies of high and standard quality. At the production unit major challenges are to: obtain and maintain a genetic stock; prevent and control pests and diseases; choose an appropriate facility design and technology to control temperature, humidity and light; use left-over substrates as fertilizer; and address insect welfare. The organic side-stream chosen as feed is of crucial importance as it influences costs, larval development, and the nutritional and food safety quality of the end product. Most edible insect species appear to be good sources of aminoacids, fatty acids and micronutrients. Processing can be a simple drying and grinding of the insects or more elaborate biorefinery processes to isolate chitin, protein and fat. Consumers may be persuaded by concentrating on tastiness, product design, marketing and promotion. The legal environment to produce and market insect products is often not conducive and needs major attention. The sector faces huge challenges and needs pro-active support by regional and (inter) national authorities in terms of legislation, research and training. Large companies are often very secretive about their operations but what about farmers who want to shift from livestock to mini-livestock? There seems obvious that a new sector is emerging, but it can only be successful if the challenges are met when private, public and academic institutions join forces (Huis, 2018).

On the other hand, the EAT-*Lancet* Commission has published a comprehensive study on healthy diets from sustainable food systems (Willett et al., 2019). This commission is a co-chaired by Walter Willett, professor at the Harvard T.H. Chan School of Public Health, Harvard Medical School, Channing Division of Network Medicine, Brigham and Women's Hospital, Boston, Massachusetts, and Johan Rockström, professor at the Potsdam Institute for Climate Impact Research, Potsdam, Germany, and at the Stockholm Resilience Centre, Stockholm, Sweden. The EAT-*Lancet* Commission brought together 19 commissioners and 18 co-authors from 16 countries in various fields including human health, agriculture, political science and environmental sustainability. The Stockholm Resilience Centre hosted the EAT-*Lancet* Commission secretariat and

co-led the commission's research activities with EAT. A global, non-profit foundation, EAT has been established by the Stordalen Foundation, Stockholm Resilience Centre and Wellcome Trust to facilitate a food system transformation. To ensure success, EAT connects and partners across science, policy, business and civil society to achieve five urgent and radical transformations by 2050: shift the world to healthy, tasty and sustainable diets; realign food-system priorities for people and planet; produce more of the right food, from less; safeguard our land and oceans; radically reduce food losses and waste. In the study published by Willett et al. (2019), mention has been made of other protein sources such as insects, which are important in some traditional diets and are being considered for widespread consumption. These alternatives might have little effect on the environment, but their long-term health effects have not been studied.

The French Insect Biology Research Institute (IRBI) explained nevertheless that its research and expertise aimed at answering the following questions: Which are the best conditions of light, temperature and humidity for insect farming? Which insect density leads to the best reproductive conditions? Which type of food should be preferred? These are the issues of insect farming that can supply food. But, besides a few cases of farming, e.g. in Vietnam and Thailand, insect consumption or entomophagy relies on collecting insects in their natural environment. In Thailand, for instance, Romain Fessard, who has eaten and appreciated silk worms, wanted to create a business aimed at supplying big quantities of these worms for human consumption. He therefore created his own farm where he has been raising a dozen of species, including silk worms, crickets and locusts, since 2009; feed includes salads, pumpkins and papayas cultivated in his vegetable orchard. "The insects are frozen before boiling them and cooking them in large woks with various spices such as basil, citronella and curry; thereafter they are dehydrated and packaged", explained R. Fessard. The packaged insects are unloaded in the French harbour of Le Havre (northwest of France) and they are sold on his Internet site, Insectes comestibles.fr, in the form of two brands: insects for snacks and cooking, and *kinjao* for protein-rich diets. R. Fessard is producing three tons of insects per month in Thailand and his business catalogue includes 60 kinds of products and 13 insect species. Even though he is convinced that insects have a future as part of human food, he reckons that the main obstacle regarding their consumption is their "visual" aspect. In the absence of a legal regulation that can be expected from the enforcement of the European Union's rules on "novel foods" (January 2018), the easiest approach is to grind and incorporate them into energy foods, salted or sweetened biscuits, candies, chocolate bars or pasta. This wide variety of products containing insect ingredients can be found in delicatessen shops or purchased using the catalogues of pioneering companies (Géné, 2016b).

Is it therefore expected that eating insects, or products derived from them, could spread across the world? According to FAO, terrestrial insects include between 6 million to 10 million species, out of which one million have been described and 2,100 are edible and recorded by Wageningen University Research Laboratory of Entomology. The FAO is praising their nutritional benefits; in particular, their protein content reaches 13% to 77% of dry matter and is quite comparable to that of meat or fish. See also Dicke (2014); Huis and Vantomme (2014). Jean-Michel Chardigny,

a research director at the French National Agricultural Research Institute (INRA), who co-authored with Vincent Albouy a book titled *Des insectes au menu? Ce qui va changer dans mon alimentation au quotidien* (Insects On The Menu? What Is Going To Change In My Daily Diet, 2016), explained that insects are not a homogenous group and that their composition depends on their development stages and their habitats. Their nutritional value is not necessarily granted. However, despite these variations, many edible insects provide "good quantities of proteins and energy, they can meet human needs in aminoacids, they are rich in mono- and poly-unsaturated fatty acids, and in micronutrients," explained the FAO. These nutritional qualities could contribute to the struggle against global under- and mal-nutrtion, as stressed by Payne et al. (2016).

C.L.R. Payne, P. Scarborough and M. Rayner, of the Nuffield Department of Population Health, The British Heart Foundation Centre on Population Approaches for Non-Communicable Disease Prevention, University of Oxford, Oxford, UK, and K. Nonaka, of the Department of Intercultural Studies, Rikko University, Tokyo, Japan, carried out a study the purpose of which was to test the hypothesis that insects are nutritionally preferable to meat, using two evaluative tools that are designed to combat over- and under- nutrition. The researchers have selected 183 datalines of publicly available data on the nutrient composition of raw cuts and offal of three commonly consumed meats (beef, pork and chicken), and six commercially available insect species, for energy and 12 relevant nutrients. They applied two nutrient profiling tools to this data: the Ofcom model, which is used in the United Kingdom, and the Nutrient Value Score (NVS), which has been used in East Africa. The results showed a high diversity in insect nutritional composition. According to the Ofcom model, no insects were significantly "healthier" than meat products. The NVS assigned crickets, palm weevil larvae and mealworm a significantly healthier score than beef and chicken. No insects were statistically less healthy than meat. It was concluded that the food category "insects" contains some foods that may be effective in combating undernutrition (Payne et al., 2016).

Social acceptance

The non-acceptance by Europeans of having insects in their diet or on their menu is based on cultural reasons. It is often true that insects can induce fear or disgust. "We consider them as "dirty" animals that can transmit diseases and devastate our cropfields; and they are mainly consumed by poor people," explained Rudy Caparros, a scientist at the Laboratory of Entomology-Gembloux Agro-Bio Tech, University of Liège, Belgium. In a book co-authored under the direction of Elisabeth Motte-Florac and Philippe Le Gall (2016), the following statements were made: "Most people are not willing to eat insects, and the latter must be transformed in order to be consumed." But what would be the interest of producing insect-based biscuits, rich in proteins, when those who can buy them have already a protein-rich (or sufficient) diet. "But insects could become an alternative source of proteins instead of meat." A steak made of insects (50%) and beef (50%), or made of plant-derived products (50%) may be perhaps better accepted by consumers than the 100% vegetarian steak. With the help of AgroParisTech and INRA (National Agricultural Research Institute), and the University of Paris-Saclay, the startup Jimini's has decided to take up a challenge: integrating insects into the European diet.

Since 2017, this company has been designing and cooking seasoned whole edible insects for the aperitif. It has also launched a tasty range of energy bars made of dried fruit, almonds and cricket flour and an insect flour pasta. The startup wanted to invest in an ambitious research-and-development programme aimed at developing a new range of plant-based and animal protein substitutes. The logo of the startup is "Think bigger, Eat smaller."

Samir Mazdour (2017) of the Laboratory Ingénierie Procédés Aliments (Engineering, Processes and Foods) of AgroParisTech, the National Agricultural Research Institute (INRA) and the University of Paris-Saclay, has explained that mass-produced insects could possibly either be processed as whole insects, or fractionated into various components such as proteins, oil or chitin. The food industry is using similar techniques in this fractioning operation, in the soya and fish-farming industries for instance. Thus the preparation of protein concentrates or isolates involves the extraction of the oil from the raw material, allowing for the generation of a defatted product. S. Mezdour explained: "To imitate a beefsteak is a very complex task; therefore, we are working on a different product that would be a tasteful meal that also contains healthy nutrients." In fact, according to several experts, this kind of food would be accepted only if the insect cannot be identified within it, e.g. if it is ground and incorporated as a flour. That is the case at Essento company (Switzerland) which has been commercializing since 2017 a steak of mealworm, rice and vegetables (all ground) through 60 shops and restaurants (Picard, 2019). Another factor that may have an impact on the social acceptance of eating insects or foodstuffs made of them, is their amazing capacity to transform feed into body mass: 2 kg of feed are transformed into 1 kg of insects, compared with 5 kg of feed transformed into 1 kg of pork. This difference is even greater when one compares the quantity of feed transformed into the edible proportion of the animal. This would mean that the insect – the mealworm – is a more sustainable alternative source of protein than several meats (Picard, 2019).

Insect-based feed for domestic animals and fish farming

The main eaters of insects in Europe are not humans, but animal pets, fishes and crustaceans. For instance, Bosch et al. (2014) of the Animal Nutrition Group and of the Laboratory of Entomology of Wageningen University (Netherlands) evaluated the protein quality of a selection of insect species as potential ingredients for dog and cat foods. Their article has been published as part of the WALTHAM International Nutritional Sciences Symposium Proceedings-2013. Insect substrates were housefly pupae, adult house cricket, yellow mealworm larvae, black soldier fly larvae and pupae, etc. Reference substrates were poultry meat meal, fish meal and soybean meal. The pupae of the housefly and black soldier fly were high in protein, but were less digestible than other insect substrates. In addition to the indices of protein quality, other aspects such as efficiency of conversion of organic side streams, feasibility of mass production, product safety and pet-owner perception are important for future dog-and-cat feed application of insects as alternative protein source.

There was therefore a justification for conducting an environmental impact assessment of insect production systems, compared with other plant or fish meals. Oonincx and de

Boer (2012) have conducted a life cycle assessment (LCA) for mealworm production, in which greenhouse-effect gas production, energy use and land use were quantified and compared to conventional sources of animal protein. They found that the production of one kg of edible protein from milk, chicken, pork or beef resulted in higher greenhouse-effect gas emissions, required similar amounts of energy and much more land. The study therefore demonstrated that mealworms should be considered as a more sustainable source of edible protein (alternative to chicken, pork and beef). Later on, in 2014, Joel Aubin, a research engineer at the National Agricultural Research Institute (INRA) in Rennes (Brettany), in charge of the environmental assessment of the insect production systems of the French National Research Agency (ANR) Desirable project, also published a paper on the environmental footprint of meat and meat products. He applied the Life Cycle Assessment (LCA) method for the environmental assessment of agricultural products and especially meat products. This method is widely accepted to quantify such parameters as land or fossil energy use, greenhouse-effect gas emissions, along the entire life cycle of a product. Thévenot et al., and Aubin (2018) have carried out the first environmental impact assessment of mealworm (*Tenebrio molitor*) meal for animal food. The study assesses the environmental performance of mealworm larvae meal via Life Cycle Assessment (LCA) from cradle to mill gate. Four parameters that experts identify as critical were used: feed intake, electricity consumption at the farm gate, electricity consumption at the processing stage, and meal and oil yield at the processing stage. Results for the five impact categories assessed for one kg of mealworm meal are 141.3 MJ (megajoules) for cumulative energy demand, 3.8 kg CO_2 equivalent for climate change, 25.6 g SO_2 equivalent for acidification potential, 15,0 g PO_4 equivalent for eutrophication potential and 4.1 m^2 per annum for land use. Per kg of protein, these impacts are higher than those of soybean or fishmeal. The uncertainty analysis indicates coefficients of variation of approximately 20%. Two main sources of variability in impacts have been identified: feed intake and meal-extraction yield. Finally, Thévenot et al., and Aubin (2018) concluded that larvae meal protein had a poor environmental performance compared with soybean or fishmeal proteins.

The French National Research Agency (ANR) has funded the Project Desirable (2012-2017), "Designing the Insect bioRefinery to contribute to a more sustainable agrifood industry," that aimed to cover the entire new insect-based industrial sector, from the sourcing to feed the insects to their final consumption in poultry and fish farms. To that end, Desirable aims to assess the performances of the larvae of the mealworm and the black-soldier fly in fish and poultry diets. These species naturally include insects in their diet. The project also includes a social and environmental study of the impact of the circular integration of insect industries in connection with other agrifood systems (Mezdour, 2017).

Within the framework of the Project Desirable, J. Aubin and his team (National Agricultural Research Institute, INRA, in Rennes, Brettany) carried out an environmental impact assessment of an industrial-scale production of mealworm flour (10,000 tons per year); the insect (*Tenebrio molitor*) feed consisted of agricultural byproducts, e.g. beet pulp, wheat bran. Nine laboratories and two companies, Ynsect and IPV food, collaborated to the study. Burel, Lessire et al. (2017) of the French National Agricultural Research Institute (INRA) and its specialized centres or laboratories involved in

aquaculture, poultry research and alternative livestock husbandry, have evaluated the nutritional value of three mealworm (*Tenebrio*) meals and two black-soldier fly (*Hermetia*) meals, partially defatted and very rich in protein – up to 75% of dry matter for *Tenebrio* and 61% of dry matter for *Hermetia* – used to rear rainbow trout juveniles at 17°C. The digestibility of *Tenebrio* and *Hermetia* proteins varied similarly from 80% to 93% depending on the meals' batches. The impact of the incorporation of insect meals on trout performance was evaluated at two incorporation rates: 15% and 30% to replace fishmeal. After four months of rearing, the growth of trout was significantly reduced when the insect meals completely replaced fishmeal. Feed consumption of trout was not reduced, but feed efficiency was decreased, especially in the case of *Hermetia*-based diets. The ingestion of feed containing insect meals did not affect the trout body composition; however, it caused yellowing of their flesh as early as 15% of incorporation and induced a smell of "soil" with 30% of *Hermetia* in the diet.

Five *Tenebrio* meals, two *Hermetia* meals, a cricket meal and buffalo-worm meals were analyzed and their digestibility measured raising chicken. Protein contents could exceed 70% of dry matter, and that of lipids 16% of dry matter. The metabolizable energy value, the digestibility of the aminoacids and of lipids were very high and could exceed 4,500 kcal/kg dry matter, 87% for aminoacids digestibility and 90% for the digestibility of certain fatty acids. These values are higher than those of soybean meal. In a growth trial, the French researchers have incorporated in balanced diets meals of *Tenebrio* or *Hermetia* at levels up to 10%-12% depending on the age of the chicken. The performances were very good, and even better than those observed with the soybean-meal control diet, in particular with *Hermetia* meal. Fat deposition and breast percentage were slightly modified by the incorporation of insect meals. To sum up, the insect meals tested are rich in proteins, with a variability due to the insect used and to the preparation process, with or without lipid extraction. Their digestibility is high, at least equal to that of the reference soybean meal and equal to that of fishmeal for *Tenebrio* meal in trout aquaculture. Their incorporation into the diets intended for these farm animals does not lead to any notable alterations, either in production performance or in cutting yields, but they may affect sensory perception in the case of trout fillets. However, there seems to be a lower effectiveness of *Tenebrio* meal in chicken and of *Hermetia* meal in fish (Burel, Lessire et al., 2017).

As of 1 July 2017, the use of insect proteins in fish farming has been authorized in the European Union. Within the French Project Desirable, funded by the National Research Agency (ANR), investigations were carried out with a view to knowing if the consumers were ready to accept products derived from insect-fed animals. The research consisted of requesting the opinions of 327 persons, recruited through the quotas method. In order to strengthen the knowledge of the sampled people, information was supplied to half of them on the benefits of insect flours or meals as substitutes of fish meals. The comparison made between the two groups of persons will permit to determine to what extent an information campaign would have an impact on the appreciation of the product value. The participants in the study had to make their choice between trout fillets from standard farms and fillets bearing the label or logo "fed with insects", with different price levels. Then, they had to fill several questionnaires concerning: their perception of feeding farmed fish or trouts, perception of feeding trout

with insect-based products, likely behaviour of consuming fish fed with insect-based products – hence a measurement of food neophobia (Poret, 2017).

The results obtained showed that 15.29% of the participants considered it was disgusting to eat trouts fed with insect-based products. This figure reached 20.49% when the participants were not informed about the benefits of insect feeding for marine resources, compared with 9.94% if they were informed. On the other hand, 67.58% of the participants were willing to consume fish fed with insect-based products. This figure increased to 73.92% in the sample of participants that have been informed, compared with 61.45% in the non-informed group. In Addition, the usefulness for the participants was decreasing regarding the product labeled with the logo "fed with insects" versus the standard product, but the impact of the label is completely reversed when the participants have been informed. It was therefore concluded that previous information on the benefits of the insect-feeding chain – regarding the preservation of marine resources thanks to fish farming with insect-based feed –, was a key factor in the consumers' acceptance (Poret, 2017).

It is worth mentioning the research-and-development European project, inVALUABLE, on insects as feed and food. This large project involved 11 partners and ran from January 2017 to December 2019 with a total budget of €3.7 million. The project's objective is to create a sustainable resource-efficient industry for animal-protein production based on insects, stated Lars-Henrik Heckmann (2017) of the Danish Technological Institute, Aarhus, Denmark. The partners of the project spanned the entire value chain and included entrepreneurs, experts in biology (entomology and nutrition), biotechnology, automation, processing and food technology and safety, as well as an international leading insect producer. Overall, inVALUABLE addresses three major challenges for the insect industry: upscaling of production to industrial level; regulatory issues; and consumer acceptance. The goal is that inVALUABLE will facilitate Danish industrial insect production to be an enabler of new market opportunities for insects as food, feed and other high-value components. The project's specific objectives were: developing an insect value chain using low-value byproducts – reintroducing valuable resources back into the food chain; document the nutritional potential of insects using state-of-the-art animal models; combine the best technologies to enable market penetration, focusing on large-scale production, automation and processing; and support Danish / European Union authorities on feed/food legislation providing data to ensure safe insect products. inVALUABLE is organized in three focal areas – Production (PRD), Processing (PRC) and Product application (PAP). The project management is coordinated by the Danish Technological Institute with a strong focus on the dissemination of project activities. Production (PRD) will focus on optimization of the production of mealworms; improving the understanding of mealworm health and nutrition; and developing innovative technologies for implementing cost-effective production systems through automation and monitoring of mealworm health. Processing (PCR) will develop processing methods of feeding substrates and insect biomass using different established and new technologies; and assess the feed/food safety of the obtained mealworm products as well as regulatory advocacy with relevant stakeholders. Product application (PAP) focuses on: how mealworm can be applied in feed and food products; the assessment and documentation of the nutritional and

health value of such products by the use of state-of-the-art animal models; the sensory feeling of insect-based products in the framework of consumer acceptance of animals fed with an insect-based diet (Heckmann, 2017).

Applying the biorefinery concept to their work on the larvae of mealworm (*Tenebrio molitor*), Mhemdi and Mezdour (2018) carried out a study on the fractionation of the raw larval material in order to obtain a liquid fraction rich in oil and a solid fraction rich in proteins. Their experiments included conventional (bleaching in hot water) and novel technologies (pulsed electric fields, ultrasounds and microwaves). Results showed that the application of a pre-treatment before pressing improves the extraction yield and reduces the extraction time. The application of electrical treatment induces cell membranes permeabilization facilitating thus the extraction step at cold temperature and preserving the product quality.

The Ynsect company is at the heart of the agrifood system that farms and processes insects into raw materials compliant with animal feed-industry standards, in particular for pet food and aquaculture feed. The company's star products are proteins (TMP for *Tenebrio molitor* protein), lipids (TMO for *Tenebrio molotor* oil) and chitin (TMK). The insect oil and proteins are produced for pet food (dogs and cats) and aquaculture (farmed fish and crustaceans) markets. The Ynsect teams of *ca*. 50 members, comprising some ten nationalities, are working on the following sites:

- research and development (R&D) and support departments in Evry Genopole, an important biotechnology cluster, located in Evry-Essonne, south of Paris;
- industrial engineering and operations department in Dole (Burgundy Franche-Comté region).

Ynsect was created by four co-founders in 2011 with a visionay idea: placing insects at the heart of the agrifood system to sustainably address the growing global demand for meat and fish proteins. In 2012, Ynsect joined a famous, innovation-oriented French incubator, Agoranov. Ynsect has also been participating in the coordination of one of the largest R&D programmes on insect-based products, the Project Desirable. In 2014, Ynsect was joined by eminent partners to develop its strategy and raised €1.8 million. It won the innovation world prize 2030 and it opened a new facility at the Genopole biocluster. In 2015, Ynsect closed a second financial round of €5.8 million and with the help of €6 milion of public support, it invested €10 million in the construction of Ynsite, a pilot farm-hill and a world premiere. In 2016, Ynsect made its first deliveries to its customers in the pet-food sector, after the opening of the pilot farm-hill, in Dole. The company was producing several hundreds tons of finished products per year. In 2017, Ynsect closed a third financial round of €14.2 million and thanks to this fund-raising it accelerated its industrial-scale development. In 2018, Ynsect announced the installation YnFarm # 1 in the vicinity of Amiens (northern France). That was the first fully automated industrial facility producing premium insect protein. The project, called FARMYNG, was co-funded by the European Commission and the Bio-Based Industries Joint Undertaking (BBIJU) that invested €20 million. In 2019, the company raised €125 million, the largest ever ag-tech funding deal outside of the United States. Ynsect draws on pioneering proprietary technology protected by

25 patents. Another fund-raising round brought the total raised to €175 million. It also filed the building permit for the world's largest insect-based production plant. With a scheduled industrial production in 2022, Ynsect will produce 100,000 tons per year of insect proteins and fertilizer. Using cutting-edge processes and meeting the highest quality and food-safety requirements, Ynsect aimed to show that its technology is scalable in numerous places in the world; and that it was able to generate orders that will in turn allow the building of a commercial unit that is 50 times more productive.

In the coming years, there might be new outlets for insect-based foodstuffs, for instance in poultry farming. But Joël Aubin made the following comment: "Does it make sense to feed insects with wheat bran or beet residues, and later on feed chicken, whereas the latter can eat directly these agricultural by-products? This adds an unnecessary stage or step in the food chain." But Antoine Hubert, chairman of Ynsect, reacted by stating: "We are multiplying by 100 our production capacity and we will become profitable and more effective from the environmental-impact viewpoint." "Moving from the laboratory to industrial-scale production is the key challenge; it is necessary to successfully and continuously produce thousands of tons per year at an affordable cost, in order to be integrated to the agrifood chains," added Frédéric Francis, a professor at the University of Liège in charge of the Laboratory of Entomology. That is why the company Ynsect will start with an output of a few tens of thousands of tons of finished product per year, and thereafter the change of scale, based on automation, will increase the overall production and decrease the cost of the finished product.

In South Africa, more than 8 billion flies are being raised by the startup company AgriProtein, Cape Town. The insect-farming plant is gobbling 250 tons of feed and farm waste, like maize stalks, potato peelings and damaged vegetables, every day. AgriProtein is among a small number of startups that are using insect larvae to produce protein-rich ingredients for animal food. Protix opened one of the world's largest insect farms in June 2019 in the Netherlands, while other producers, including Enviroflight, Ynsect (see p. 244) and AgriProtein, are building large facilities to turn billions of insects into animal protein every month. Large farming companies like Cargill and Wilbur-Ellis are also investing in this sector. By breeding insects in vertical farms, these companies can produce large amounts of feed in less space than conventional farms, their proponents stated. All the farmed insects are essentially recyclers that can turn huge amounts of organic waste into protein. "I have been to facilities that can digest a hundred tons a day of waste with these insects. That is a hundred tons of waste that would not go into a landfill. A hundred tons of waste that would not produce greenhouse-effect gases. A hundred tons of waste that would not potentially pollute the soils with pathogens," stated Jeffery Tomberlin, an entomologist at Texas A&M University who has been studying the black soldier fly for over two decades. The black soldier fly larvae favoured by the "insect-protein" industry can become 200 times bigger after eating organic wastes for ten days. These larvae can also be reared in small farms, allowing croplands to turn their organic waste into a valuable product. "You can grow these insects anywhere in the world, in developed countries and using robotics, as well as in second- and third-world locations, using wood scraps and chicken wire from your backward," stated J. Tomberlin (Garcia, 2019b).

"The high-protein ingredient we produce is being targeted towards aquaculture. I think the big end goal of this industry is to try to offset some of the needs for wild-harvested fish to produce fish meal," stated Liz Koutsos, the chief executive of Enviroflight, which opened the first commercial insect-rearing facility in the United States in November 2018. Aquaculture is the world's fastest-growing food industry, and one that requires large amounts of wild fish. According to FAO, from 1995 to 2015, the production of industrial-aquaculture feeds increased six fold, from eight to 48 million tons a year. Despite the possibilities, the insect-protein industry faces many challenges. Regulatory hurdles have hampered its growth in Europe and the United States, where black-soldier-fly products could be used to feed poultry and some fish species but not other animals, and there was no regulatory approval for the use of other insect species for this purpose in 2020. But companies were confident that regulators in the United States would lift those restrictions soon. But to scale up operations, these companies also needed to diversify their product portfolio, optimize production techniques and raise large amounts of capital. L. Koutsos stated that insect-protein companies were like chicken farmers in the 1920s, a time when chicken rearing was mostly a backyard operation and not the large-scale industry it is nowadays. "The beautiful thing is that with a 50-day life cycle from birth to breeding, which is a very short life cycle, our 1920s model will evolve much more rapidly than with longer-lived animals…" "So we will make great strides in this industry and its ability to have an impact on the environment, very quickly," stated L. Koutsos (Garcia, 2019b).

A further challenge related to insect farming on a large scale, is health and animal well-being. Over the brief history of this food chain, there have been several cases where insect populations were completely destroyed by microorganisms. For instance, in 2000, in the Netherlands, the Kreca society had lost 50% of its cricket-population in eight or 12 hours, and thereafter the whole population, most probably due to a virus; and this event occurred when it was selling more than 10,000 boxes of crickets per week. David Giron warned: "Do not repeat the errors of the past. Develop insect farming from a single strain or line, maintained thanks to antibiotics, is not the best solution." D. Giron is making a catalogue of viruses which infect crickets and black soldier flies (*Hermetia illucens*), with a view to providing diagnostic kits to the companies involved in insect farming; and in the long term to develop virus-resistant lines of insects (Picard, 2019). Natural enemies, including predators and insect pathogenic fungi and bacteria, can therefore be very harmful in insect-production systems. Many factors can influence if there will be a risk of harmful natural enemies to enter production systems and result in problems. The first element is the production facility itself, where closed-production facilities versus semi-open facilities provide different risks for entry (from the environment, via feed) and further spread in the production facilities. The second element is which type of insect we deal with and thereby which insect pathogens can be harmful. For instance, while mealworm (*Tenebrio molitor*) may suffer from fungal diseases and a virus disease can completely wipe out a production stock of house cricket (*Acheta domesticus*), black soldier fly (*Hermetia illucens*) seem so far relatively free of diseases. In Europe, a collaboration network "INSECTPATH" about diagnosis and control of insect diseases and involving several teams has been established, as mentioned by Jørgen Eilenberg (2017) of the Department of Plant and Environmental Sciences, University of Copenhagen, Denmark.

Regarding animal well-being, are the five principles issued by the World Animal Health Organization relevant? These are: prevent starving, thirst and malnutrition; prevent fear and distress; no physical or thermal stress; lack of pain, lesions and disease; and capacity for the animal to express the normal species behaviours. "The criteria of measuring pain have been designed for Vertebrates. In the case of insects we do not know the mechanisms in their brain and the specific areas of pain perception," explained Claudio Lazzari, professor at the Insect Biology Research Institute (IBRI) in Tours, France. However, thanks to receptors that are sensitive to dangerous stimuli, they can react quickly in order to protect themselves – for instance, they can lift up their legs to avoid a very hot surface. We also ignore the various causes of insects' behaviour, and if there is a stress hormone in insects. But some natural behaviours could make difficult the maintenance of insect farming. For instance, mealworms can eat larvae during metamorphosis, as well as pupae or eggs; such behaviour is exacerbated by the increase in worm density (Picard, 2019).

When many countries will decide to industrially produce some insect species, the old prophecy of Vincent M. Holt would become a reality. In 1885, this British entomologist predicted the following, in a small pamphlet titled *Why not eat insects*?: "While I am certain that they will never decide to eat us, I am also certain that once we have discovered how they are good to eat, we shall be glad to cook and taste them." V.M. Holt published this pamphlet when he was seriously concerned about the catastrophic food-and-nutrition conditions of the workers' class during the 19th century.

Regulatory framework

"Any sale of insects for human food consumption is illegal, even in restaurants," recalled the attorney Katia Merten-Lentz, a specialist of agrifood law at Keller and Heckman lawyers' office. However, since the 1st of January 2018, insect-based food, whether the insects are included as a whole or fragmented, has been submitted to the prior authorization by the European Commission. Since then, insect-based food has been possibly reaching the consumers' plates thanks to the European Commission. Two of them were made by the company Micronutris, located in the French city of Toulouse (southwest of France) and which farms crickets and flour worms in order to manufacture biscuits, pasta and snacks. At the beginning of 2019, three files were being evaluated by the European Food Safety Authority (EFSA), in charge of evaluating any health risk on behalf of the European Commission (Picard, 2019).

Special attention is paid to allergenic substances quite common in arthropods such as crustaceans (shrimp, lobster). "Persons who are allergic to crustaceans should not eat insect-based food," stated Charlotte Grastilleur, deputy-director for risk evaluation at the French National Agency for Food Sanitary Safety (ANSES, French acronym). Another drawback of insect-based food could be the accumulation of heavy metals – e.g. cadmium, lead – present in insects' bodies. There is therefore a need to feed the animals with high-quality feed, because they have a low capacity of metabolite excretion, according to C. Grastilleur. For instance, it is out of question to raise black soldier flies (*Hermetia illucens*) on dung or pig manure, and then to give them as feed to domestic animals. Insects may harbour harmful bacteria and in 2018, research work by Swedish scientists has confirmed that the number of these bacteria was high

in domestic crickets; they therefore recommended strict hygiene criteria and specific health-safety measures. The EFSA, as well as the French ANSES, have underscored the poor knowledge of the safety issues regarding insect-based food. This kind of information is requested from those who apply to both agencies for the authorization of insect-based food. The latter must check the information supplied and underline the gaps and uncertainties in their final recommendation. In the case of EFSA, nine months are necessary before any advice can be issued. Further to the first EFSA's advices, the European Commission was expected to make a decision, in the fall of 2019, on the commercialization of the first insect-based foodstuffs in the European Union (Picard, 2019). "Regulators from the United States, the European Union and Asia are quickly understanding that insect farming is a natural process," stated Jason Drew, South Africa AgriProtein's chief executive officer, and whose company plans to open facilities in California, the Netherlands, Singapore and South Korea. "Regulators tend to support this type of industry rather than hamper it because it has immense environmental benefits," he emphatically stated (Garcia, 2019b).

Automating cookery

Creator, a new hamburger joint in San Francisco, claims to deliver a burger worth US$18 for US$6 – in other words, to provide the quality associated with posh restaurants at a fast-food price. The substance behind this claim is that its *chef-de-cuisine* is a robot. What works for one sort of fast food can work for others. Though the business of pizza making has not yet been robotized completely, Zume Pizza, also based in California, is getting close. It has been a team of "doughbots" that speed up stretching the dough from 45 seconds to just nine. The toppings still have to be made the conventional way, but the firm has robotized the dispensing and spreading of them, and also the moving of topped pizzas into and out of ovens (*The Economist*, 2018).

Until recently, catering robots have been gimmicks. "Flippy", a robotic arm that flipped burgers for the entertainment of customers at CaliBurger in Pasadena, near Los Angeles, at the beginning of 2018 is a prime example. But Flippy could perform only one task. Creator's bot automates the whole process of preparing a burger. Other robot chefs that can prepare entire meals are working in kitchens in other parts of America, as well as in China and the United Kingdom. Creator's burger bot is a trolley-sized unit that has a footprint of two square meters. Customers send it their orders via a tablet. They are able to customize everything from how well-done the burger will be to the type of cheese and toppings they want. The robot grinds the meat, form the patties, griddles them – a process tracked by 11 thermal sensors –, chops tomatoes and grates cheese for those who want such toppings, slices, toasts and butters the bun, and dispenses seasoning and sauces. It then assembles and bags the finished product, so that it is ready to go. The process took eight years to be perfect. As far back as 2012, a mere two years into the project, the machine was described as "95% reliable," but that is not enough for a busy kitchen. Chopping tomatoes was a particularly tough challenge, but even details like the paddle which packs the burger into a bag without squashing it were tricky to master. Only by mid-2018, with a machine they claim can turn out, reliably, 120 burgers an hour, do Alex Vardakostas, the engineer behind the project, and his co-founders – a mixture of technologists and caterers – felt confident enough to open their first restaurant (*The Economist*, 2018).

Over America's east coast, in Boston, a restaurant called Spyce offers more fashionable robot-created fare. Customers order from a touchscreen menu and can watch the robot measure, mix and cook dishes ranging from "Latin" – black beans and roasted chicken with chilli and avocado on brown rice – to "Hearth" – balsamic-glazed sprouts and sweet potato with kale and quiñoa – in an inductively heated wok. Woks stand in a row beneath a conveyor belt, which automatically delivers the correct ingredients to each. They are then mixed and cooked before a human server adds toppings. As with Creator's robot, speed is a primary factor. Spyce's bot can prepare dishes in three minutes (*The Economist*, 2018).

In China, Li Zhiming, an entrepreneur, has developed a robot that can cook any of 40 recipes from Hunan province. Much of Hunan's cuisine involves heating food rapidly in oil, a process that is difficult to mechanize because of the number of different ingredients which have to be cooked "just so". Li Zhiming has spent four years developing robots that can do this. They work in a similar way to Spyce's, by dispensing precise quantities of each ingredient from a series of hoppers in sequence, then stirring them in a wok over a gas flame at an exact temperature for a specific, recipe-dependent time. When a meal is complete, the robot serves it into a bowl, then cleans out the cooking pot ready for the next order. Li Zhiming opened his first robot-catered restaurant in May 2018 in Changsha, Hunan's capital. Its kitchen is staffed by three bots and two human beings. Normally, he stated, a restaurant of this size, offering that sort of variety, would have a kitchen staff of eight. Li Zhiming's ambitions, moreover, reach far beyond Hunan. He thinks the main reason such delicious dishes as clay-pot rice with vegetables, pepper-fried pork and cumin-beef stir fry are not better known outside their native province is a lack of trained chefs. He hopes his robots will overcome that difficulty and make Hunan's cuisine as easy to franchise as fried chicken and hamburgers – and as popular (*The Economist*, 2018).

For fast-food restaurants, in which the cooking is something akin to an assembly-line, robotic kitchens with limited repertoires – burgers, pizzas, grain bowls, Hunan dishes and so on – look like a promising innovation. For real foodies, though, a robot that can turn its hand to almost anything culinary would be the acme of automation. And Moley Robotics, a British firm, aspires to do just that. Its robot chef is intended to emulate a real one – not only in the quality of the meals, but also by being able to learn to cook almost any recipe. This project is a more complicated proposition than an assembly-line robot and is, it must be said, behind schedule. The firm had hoped to launch it in 2017, but they stated later on that it would be available by the end of 2019. It features a pair of arms with human-like hands. These manipulate ingredients, utensils and heat sources in a well-equipped kitchen. The robot draws on a databank of recipes that are records of the actions of a human master chef collected by a motion-capture system, so that the machine can copy them exactly – whisking eggs, slicing onions or frying bacon. A robot like this could therefore cook thousands of different recipes, on demand. Moley Robotics' target appears to be the luxury domestic market, rather than the restaurant trade. If it is successful in the houses of the rich, though, sous-chefs everywhere might understandably get nervous about how much of their work could be automated. The catering industry is known for low pay, so automation is not an obvious cost-saver. It is probably, however, a quality and reliability enhancer, and in a field with fickle customers, and competitors around every corner, that could count for a lot (*The Economist*, 2018).

CONCLUSIONS AND PROSPECTS

The various diets have almost been reviewed, as well as the on-going changes of eating habits and the trend towards culinary cosmopolitism. Let us recall the so-called diets "without":

- the vegetarians do not eat neither meat, nor fish;
- the vegetalians are like the vegetarians, but in addition they do not eat anything that is derived from the animal or created by it, such as milk, cheese, eggs or honey;
- the vegans are adopting a lifestyle that rejects any product derived from animals, or from their exploitation or from tests applied to them – leather, fur, wool, bee wax, cosmetics or medicines;
- the pescetarians who do not eat any animal meat, except fish and seafood;
- the crudivores who eat only raw food;
- the flexitarians try to reduce their consumption of animal proteins;
- the gluten-free consumers have a gluten-free diet which does not contain this protein present in many cereals such as wheat, barley or rye;
- the lactose-free consumers avoid products that contain lactose – milk, cheeses, yoghurt;
- the zero-sugar consumers who do not eat foodstuffs or drink beverages containing sugar (saccharose and fructose), e.g. fruit and honey.

What is next?

Meeting the food basic needs of the poor remains today a major challenge for humankind. For instance, many sub-Saharan African nations still include a large proportion of extreme poor and sometimes starving people. Increasing crop yields is a necessity, not only the minimum kilocalories a day, but also the daily intake of macro- and micro- nutrients in order to combat malnutrition. At the same time, this food supply should be sustainable and, as much as possible, not detrimental to the environment. Efforts made in agroecology could certainly contribute to fostering a sustainable agricultural development. Precision agriculture, which relies on artificial intelligence

and human-made tools that help improving cropping practices, is becoming the new "green revolution" of our time. Developing countries should benefit from it, in order to optimize agricultural inputs and maximize the outputs, such as crop yields.

Over the years, people have adopted eating and drinking habits which are considered appropriate or healthy, or are unhealthy with considerable risks of developing a wide range of diseases in addition to malnutrition. In this respect, nutrition has come to the foreground of humankind's concerns. It is not a subsidiary issue: in other words, the quality of foodstuffs in the daily intake is as important as their quantity. That is why in the preceding chapters various forms of eating habits have been described, such as fast food, very often assimilated to "junk food", street food, slow food, organic food and vegan diets. There is also a list of diets deprived of some food compounds. The adoption of all these diets is dependent on the economic conditions of people: from the poor to the middle, upper and even higher middle classes, and to the very wealthy. But it has also been repeatedly shown that educating people, and particularly the youth, can lead to changes in behaviour towards more balanced and healthier diets. Even for the very poor food aid can help meet their food basic needs, as well as their nutritional requirements.

Another remarkable trend is how each of these categories of eating and drinking behaviours is evolving: for instance, fast food and street food are paying more attention to nutritional advice and recommendations; they put more vegetables or salad in their fast menus, keeping nevertheless the overall cost affordable. Sometimes, these behaviours become quite sophisticated not only regarding the variety, savours and presentation of menus, but also sometimes regarding the pleasant environment where they operate. "Attending quickly, but still enjoying good food, in a beautiful environment" could apply to a place initially devoted to fast food. Also street food could become clean food, rapidly served, savoury and affordable; it is sometimes inspired by the slow food movement. Even the ancient sandwich and the more recent kebab have become healthier and at the same time remain affordable for the great majority of people with limited resources. Furthermore, the big commercial interests which are behind sweetened beverages or fast food have been aware of the changes in eating and drinking habits, as well as of the demands of governmental health authorities, aimed at gradually, and sometimes drastically, improving the nutritional value of their products. The food and beverage industries understand that their annual turnover could be equally important if they move toward the production of healthier foodstuffs and of less sweet or sugar-free beverages or simply pure water. Industrial agrifood and beverage companies are closely monitoring the new demands of consumers regarding healthier foods and more balanced diets. The adaptation of their business strategy is guided by the fact that the new food-consumption trend is expected to last and it needs quick responses.

Organic food is undoubtedly a good solution, both from the farming viewpoint and from the quality of its products. Still many challenges remain, regarding its extension, the yields achieved, the cost of the final products. It is also a way to shorten the distance between producers and consumers; as part of circular economy one could eat

locally and consume homegrown foodstuffs at the right season. In fact, an increasing number of restaurants and their chefs try to do so and they are thus contributing to decreasing the environmental footprint of food production and consumption.

For the upper end of cuisine sophistication, there exists across the world a great diversity, often rooted in old traditions that are sometimes revisited, but it is also due to the skills and imagination of chefs. These are guided by: making a meal a very enjoyable moment – sociably and gustatory; selecting the best food ingredients during the right season; cooking them without losing most of their nutrients; bringing in the flavours and savours of spices and condiments that do not change too much the basic taste of the main meal; giving their personal touch to the recipe, the decoration of the meals and their catering. There have been many waves in this trendy, sophisticated and expensive cuisine. But it is also remarkable to underline the growing trend of culinary cosmopolitanism, of the interest in making fusions between culinary traditions, particularly between the Far East cuisine and the Western one, with the inputs of Hispanic and Mediterranean cuisines and diets. The result is often surprising and it confirms that the blending of cultures is not confined to the fine arts and crafts, but also to the eating and drinking habits. There are many cities, places and restaurants that are famous for the variety of their cuisines, and distinctions are awarded each year to the best of them. Fashion plays certainly a role in this acknowledgement, but also in the way the cuisines evolve over time. It is similarly true that the sophistication trend could clash with that of authenticity: we can certainly meet our food needs, while having an affordable daily diet consisting of fresh produce and nutritionally balanced ingredients.

Finally, environment and ethics issues are increasingly present in the debate on what to eat and how to eat. Decreasing, for instance, the consumption of raw meat, especially in the developed world, partly replacing it by plant-origin substitutes or even by *in-vitro* produced meat, is not only good for the health of the consumers, but it will also reduce the ecological footprint of farming and livestock husbandry. Moreover, the rather wide range of vegan diets is based on the firm beliefs that animals are very badly treated, not only regarding their husbandry but also the ways they are slaughtered. The debate is far from over between those who want to drastically reduce or even erase livestock husbandry, and those who totally disagree, while nevertheless recognizing that domestic animals should be treated much better. And there are those who suggest various intermediate measures, in terms of meat consumption, livestock husbandry and slaughter process. Certainly, these ethical issues will increasingly be present in the worldwide debate on our present and future eating habits.

What is next? It means precisely where are we heading for? It is not so easy to prepare a standard menu, e.g. because taking account of the list of "without" options can become a headache. Moreover, such variety of alternative diets may not be easily accepted in a specific country – such as France, where culinary tradition is so deeply rooted. Some, like Solène Lhénoret (2019b), have used the phrase, "a tectonic of dishes", when trying to explain this difficulty. Some illustrative pathways are given below.

How to combine the pleasure of eating and the diversity of diets

In France, having a good meal is of great relevance. In November 2010, an intergovernmental committee of the United Nations Educational, Scientific and Cultural Organization (UNESCO) decided to put the "French gastronomic meal" on the World's List of Non-Physical Cultural Heritage. This French meal should comply with some conditions "regarding the time, the hours, space and location – e.g. eating at a table –, the composition of the menu – including a starter, a main course and a dessert. And it must be shared with someone," explained Claude Fischler, a sociologist specialized in food issues and emeritus research director at the French National Scientific Research Centre (CNRS). The decision made by UNESCO was a worldwide recognition of French cuisine and of the eating habits that accompany it. In March 2018, the Organization for Economic Cooperation and Development (OECD) published data concerning the average time French people are sitting to share a meal: *ca*. 2 hours and 13 minutes per day, while the average in the other OECD member countries was 1 hour and 30 minutes (Lhénoret, 2019b).

By contrast with countries of Protestant faith, France has been influenced by a catholic tradition which considers that sharing a meal is a communion. In all religions – except Protestantism, where those sharing this faith are allowed to eat everything, and at any time on the condition that they should not draw pleasure from it – there is a common practice of fasting, explained Eric Birlouez, professor of food at AgroParisTech. "That is called sometimes fasting: one abstains to eat some foodstuffs during a certain period, e.g. during the Lent period among Christians, the month of Ramadan among Muslims, or the Yom Kippur among Jews, etc. During these periods the human being can fully dominate his or her food pulsions as well as sexual ones. One should be able to demonstrate that the spirit is stronger than the body," explained E. Birlouez (Lhénoret, 2019b).

In France and in general in the Southern European countries sharing meals is a pleasure of being together and spend a good time. E. Birlouez considered that it is not courteous to refuse what is being offered to you. In this regard, it is true that when a family gathers around the table to share a meal, there is a rule which young children learn: "You must taste first before saying I do not like …" Consequently, having around the table somebody who has a specific diet – and does not eat like everybody else – disorganizes the structure of the meal prepared by the household. This behaviour could be perceived as a distrust of the host. And the guest also becomes suspicious. Claude Fischler (2001, 2013) recalled that "in accordance with the norms of universal hospitality, there is a phenomenon of reciprocity – a two-way process." While in the Anglo-Saxon countries bringing one's food does not raise a major problem, this was, in France for a long time, as way of isolating oneself. Comparing France with Germany, there are clearcut disparities regarding food choices or diets: the latter are much better accepted in Germany, particularly in the restaurants that systematically give on their menus the composition of the meals to be served.

There is in France a steady increase in these specific diets. In 2017, the Observatory for Society and Consumption (*L'Observatoire société et consommation*, OBSOCO) has published a study on the food behaviours and ethics of French people, showing

that 21% among them stated that they had a permanent specific diet. These include the flexitarians – who reduce their consumption of red meat, but are not exclusively vegetarians (8% of respondents); they were followed by those who have banned sugar from their diet (4%); then by those who stated that they consumed only organic products (1%). The study has also shown that half of the French people stated that they have modified their diet over recent years. While these diets are accepted or tolerated if they are based on a medical prescription – e.g. gluten- or sugar-free diets –, the acceptance is more complicated when they are related to physical or mental well-being. However, one should distinguish those diets from which a toxic foodstuff has been eliminated, from "what is more related to fashion or some kind of culinary trend. "For instance, many people have adopted a gluten-free diet, e.g. those belonging to the professions of fashion and design, the media and many celebs … One day, it is the pulp of the baobab tree, the day after it is coconut juice, which become fashionable; this is a way to socially distinguish oneself: in other words, I confirm my identity of consumer and others should accept it. I am not alone, there is behind me a real or virtual community," stated E. Birlouez (Lhénoret, 2019b).

"One has also to highlight those diet preferences relating to the environment and animal well-being, because the consumers want to have a positive impact on the planet. To eat is also to participate in environment protection and to struggle against food wastage … "In some social environments, this kind of behaviour is fully accepted and begins to be part of the usual habits," added E. Birlouez. Claude Fischler (2013) thinks that our society is going through a deep crisis of trust towards food and nutrition. "Fifty years ago, people started to say: With modern, industrial and transformed food, we do not know what we are eating." And this is a serious problem because "we are what we eat". Then, the statement became: "We indeed do not know what to eat." We are now in an era of mistrust. And because of that, everyone goes back to his/her own recipes, or makes decisions to protect oneself, e.g. preference for organic products, homegrown food ingredients, etc. The final objective being to build a new relationship with food. For instance, Solène Lhénoret (2019b) mentioned the case of a French young woman who became a vegetarian after several months of struggle, because "the social pressure within the family, among friends and at the restaurants was very strong." According to her, France is far behind Germany in terms of social acceptance of diet changes; she could notice the behaviour of people in Munich, Bavaria, where she has been living since 2017. Even in Bavaria, which is renowned for its sausages, there is always a vegetarian dish on the restaurant menu. S. Lhénoret (2019b) also mentioned that this woman could prepare a vegetarian Christmas meal.

Maybe a special mention should be made of the spicy-food trend that is quite often present in the dishes across the world. According to José Carlos Capel, a food critic for the Spanish daily newspaper *El País*, spices can enhance the flavour and savour of dishes, or detract from the enjoyment of other foodstuffs. Most spicy ingredients affect the taste buds, but others rise through our nostrils in a form of vapour, like Japan's *wasabi*, a decongestive radish. Spiciness is not traditionally part of European culinary culture. There are few Old-Continent dishes that include the flavours and savours of mustards, paprika, horseradish or peppercorns such as the Hungarian goulash. In the rest of the world, there are several areas that should be mentioned: Mexico, Thailand

and India, as well as some particular regions of Korea with its *kimchi* – fermented cabbage and chilli – North Africa (with its *harissa* paste) and China's Sichuan cuisine, where chillis and spices play a key role in the preparation of many dishes. Some appreciate a gentle heat (known as *poco picoso* in Mexico). Those who are bolder bear the aggressive heat of Carolina Reaper chilli, the world's hottest, according to J.C. Capel. The latter remembered the feeling of being paralyzed by pain in restaurants or street-food stands because of the *rocoto* in Peru, the *habanero* in Mexico and the *malagueta* in Brazil: a kind of hell in the mouth that sometimes takes minutes to disappear. That happened to him when he ate a pork crackling sandwich with hot sauce (*guacamaya*) in the city of Guanajuato, Mexico. There seems to be a boom of spiciness in Europe, due to the influx of Latin American and Asian cuisines. There are many accounts of the direct or indirect effects of hot spices: the capsaicin is responsible for the spicy sensation, it has apparently multiple effects, like slimming, preventing certain types of cancer, neutralizing intestinal illnesses, activating bloodstream flow and even releasing endorphins. J.C. Capel likes moderate spiciness in the food and he quoted the best testimony in favour of the culture of spiciness: that of the Mexican chef Roberto Ruiz at Madrid's restaurant Punto MX. The latter explained the reason behind the use of each of the chillies in his creative dishes: "The hard part is knowing how to match them with the other ingredients in order to enhance each recipe."

Crossbreeding of culinary traditions and multiculturalism

In 2016, a mayor of a French small southern city stated that there were in his town too many shops or restaurants selling kebabs. And he added: "these businesses have nothing to do with our culture." The politician who was a strong supporter of the preservation of France's cultural identity was extending it to food and eating habits. This approach was defined by Jean-Pierre Corbeau (2000), emeritus professor of sociology and vice-president of the European Institute for Food history and Cultures, as the "refusal paradigm." "This consists of rejecting innovation, of refusing any change in the production of foodstuffs, and of forbidding any transgression from the food index …" "We hide away from otherness and we incorporate totem foodstuffs in order to maintain an identity filiation with a non-changing heritage, that would float – as through wizzardry – on a rough sea!" Such a silly hope of purity is part of a "myth", underlined J.-P. Corbeau, because feeding oneself is not fixed for ever in culinary traditions; it relentlessly combines the old and the new, the closer and the farther, the familiar and the strange (Corbeau, 2000).

According to Dora De Lima and David Do Paço (2012), "gastronomies are not lifeless, nor are they remnants of heritage that should be protected. On the contrary, they depend on a society's material resources, on the social strategies of the groups that use them; they also accompany the changes occurring in these societies and groups. Consequently, they cannot be examined without taking account of the crossbreeding or fusion that penetrate them, maintain and transform them." When in 2010, after having rejected to put the French gastronomy on the World's List of Non-Physical Cultural Heritage, and suggested that France should revise its application file and focus it on the gastronomic meal, the United Nations Educational, Scientific and Cultural Organization had excluded the likelihood to make gastronomy a tool of an

identity policy. On the contrary, UNESCO well confirmed that gastronomy develops around practices, that could be based on rituals, but they are flexible enough to be able to permanently incorporate new elements (food ingredients, dishes, techniques, consumption areas or spots, taboos) and actors (economic, social, religious, cultural, political). It is therefore acknowledged that gastronomy goes through crossbreeding or fusion (De Lima and Do Paço, 2017). Both historians went on to elaborate on the meaning of the word crossbreeding or fusion. It could be considered as a kind of resistance to negotiate with the practices and tastes of the conqueror, and blended with those of the conquered, before the latter realize that the end product should be conceived as an identity niche to be safeguarded. According to this domination logics, crossbreeding or fusion does not occur exclusively between distinct cultures, but it can be analyzed within a society. Crossbreeding or fusion is then a permanent process of integration and transformation of elements that are exogenous to a society's practices. As underlined by Jean-Loup Amselle (1990), crossbreeding or fusion should be considered as "a mixture of which the elements cannot be dissociated."

This permanent fusion of exogenous elements generates a transformation of both of what is integrated and the structures which operate this transformation. Crossbreeding or fusion can be perceived as a total assimilation or a rejection, depending on the constraints and the people's strategies and resources. Finally, crossbreeding or fusion is present between and within all gastronomies, i.e. between societies and the social groups with the whole range of their diversities. There is no gastronomy without crossbreeding and, consequently, gastronomy cannot be patrimonial, i.e. becoming a political tool that freezes and imposes it. It slips out of the hands of those who want to make it theirs. In this sense, Hélène d'Almeida-Topor (2000) reaffirms the existence of culinary fusions. She has listed three stages of this fusion: the transplant of a raw product, the preparation of meals and commensality. De Lima and Do Paço (2012) have reviewed American, African and European societies from the Antiquity to nowadays with a view to observing the crossbreeding or fusions occurring between the societies and within them. Thus, gastronomy has been perceived as a social fact and has been approached through its practices. This review has shown that gastronomic crossbreeding or fusion has been that of commensality in Rome, Massawa and Vienna, as well as that of meal in Ethiopia, Angola and the United States; the researchers have therefore replaced this fusion in a broad sociocultural history.

In fact, gastronomic crossbreeding or fusion is everywhere. For instance, in Ethiopia from the 16th to the 19th century, at the crossroads of African, Indian and Ottoman influences, but also Christian and Moslem ones; at a more local scale, the gastronomic fusion emerges in a harbour society which makes the link between the seashore environment ant that of the highlands. In Angola, during the 16th century, the discovery of some fruits by the Portuguese and the beginning of their transAtlantic trade leads to their integration in the current knowledge, but also to a perception of the world by the Europeans; they also led to preservation methods, a selection and transformation of the product, as well as to its consumption habits. In the United States, since the First World War, gastronomic crossbreeding or fusion is the end result of a seizure which pays no heed to culinary identities or consumption habits. When the latter are first received in the American territory and thereafter thrown out across the world, they

repeal the caricature of the fast-food culture and they highlight the existence of a real American gastronomy. In the 18th century, in Vienna, it was the transformation of the town and of its social fabric that has permitted to overcome the community debate and to understand the introduction and expansion of coffee, while trying to imitate its consumption in London, Paris or Venice, and also through a privileged trade with the Ottoman world. Finally, in the Ancient Rome, it was in the *propina* that crossbreeding or fusion occurs among social groups which were divided by birth and law; and this is a powerful brake put on the gastronomic discourse of the elite that bluntly deny the reality (De Lima and Do Paço, 2012).

France, that is in Europe the oldest country of immigration, has received at the end of the 19th and the beginning of the 20th century hundreds of thousands of Belgians, Italians and Poles who were seeking work. After the Second World War, they were followed by tens of thousands of Portuguese, North Africans (from the Maghreb), Asians and sub-Saharians. In 150 years, migratory waves have transformed France into the "America of Europe," according to the historian Gérard Noiriel. Such intermingling, which was unique in Europe, had a profound impact on the culinary traditions. With the arrival of these new immigrants French people have discovered new savours and flavours, spices and new ways of cooking. On their side, the migrants had to abandon some know-how, modify some culinary rituals and adapt the recipes brought from their homeland. As explained by Laurence Tibère, a social scientist and researcher at the Toulouse Jean-Jaurès University, "when traditions are side by side, they crossbreed and hybridize themselves." The culinary language is so deeply carved in the mind of all those who "eat", that it does not disappear from one day to another. Nowadays, as in the late 19th century, migrants who settle in France make attempts to keep and transmit the culinary rituals of their homelands. Nevertheless, culinary practices of the migrants are not fossilized or motionless. Whatever their origin – Vietnam, Morocco, China, Côte d'Ivoire or Togo – these immigrants not only repeat the recipes of their countries, but they also try to reinvent them (Chemin, 2019).

Let us take the example of pizza. This culinary preparation has an old story: the word has been found in a document written in medieval Latin in 997 and conserved in a cathedral near Naples. In her book titled *Pizza, cultures et mondialisation* (Pizza, Cultures And Globalization, 2016, edited by the National Scientific Research Centre, CNRS), the anthropologist Sylvie Sanchez recalls the amazing history of the global success of this dish. During the 19th century, the pizza is a salted, baked dough which the Italian people eat in the streets. In 1844, Alexandre Dumas, the French famous novelist, wrote: "Pizza can be made with oil, bacon, lard, or with cheese, tomatoes and small fish." S. Sanchez explained that "this variety of ingredients aims at breaking the monotony of the daily diet of poor people who consume this cheapest meal available on the market." J.-P. Corbeau (2000), on his side, explained: "One believes that pizza and pasta arrived in France with the Italian immigrants at the end of the 20th century. In fact, these meals were disseminated through the second and even the third generation of migrants. At the beginning of the 20th century, the Italians belonging to the lower social classes used to eat traditional dishes, but they did it at home with the help of cultural transmission and women's culinary memory." Regarding the United States, the hundreds of thousands of Italian immigrants traveling to the New World during

the 19th and 20th centuries brought the pizza into their new country of adoption. A first "laboratorio" managed by the De Lorenzo brothers opened in 1885 in Little Italy, New York's Italian district. During the following decades, the first pizzerias opened in the French southeastern city of Marseille – an important destination of immigrants coming from Naples and its region – and thereafter in other French towns (Chemin, 2019; Corbeau, 2019). After the Second World War, Italian cuisine spread on a large scale and it even became part of the agroindustry, e.g. Panzani or Buitoni. S. Sanchez also confirmed that pizza was present across the whole world after the Second World War. Such amazing success story was due, according to the French anthropologist, to the meal's extreme plasticity: "It is not a meal or part of a meal, it is a meal by itself. Pizza is salted or sweetened; it can be a hot or cold dish. It fits any consumption context and responds to opposed needs. It can be a snack to nibble at any time or it could be a robust and hearty dish... To sum up, the pizza does not comply with the rules generally applied to the service of a meal, as well as with the etiquette recommendations" (Chemin, 2019).

The same story applies to the Poles: at the end of the 19th and the beginning of the 20th centuries, a majority of immigrants from Eastern European countries used to live in what we may call today ghettos. Their culinary traditions were transmitted within the family environment, but they were absent in the public arena. Later on, the migrations from Eastern European countries were related to that of the Jewish diaspora, and as a result meals and pastries were sold in shops and in the urban environment. During the 1960s or 1970s, the Portuguese, and, to a large extent, the communities that came before them to France, used to live between themselves. Men were working in the nearby factories, while their wives were employed in families belonging to the gentry, where they used to do house-cleaning, ironing and also cooked the meals; in this way they could facilitate the adoption of Portuguese dishes such as, for instance, many cod preparations (Corbeau, 2019).

Regarding Asian cuisine, it became rooted in France thanks to the opening of Cambodian, Japanese, and above all Vietnamese restaurants. In the latter, lunches and dinners were not very expensive, the cuisine was unusual and one could eat meals without following a precise order, using sticks instead of forks and knives, and even the fingers. Such a freedom upheaved the traditional codes or norms of the French lunch or dinner. In Asian restaurants, French people discovered food with surprising savours and flavours, unusual slicing of the foodstuffs – e.g. very thin slices of meat, coriander and ginger – and the blending of sweet and salty, of sweet and sour. In fact, sweet and sour savours already existed in the French cuisine, but they have been forgotten. In the Middle Ages, in the first books of recipes those flavours were very present, but during the following centuries the sauces based on butter prevailed. The Asian cuisine that French people have discovered in the Vietnamese or Japanese restaurants during the 1980s and the 1990s, was distinct from the oily preparations that were at the core of the French traditional cuisine during the 19th century and the beginning of the 20th. The Asian cuisine emphasizes the freshness of the product; cooking is fast and the percentage of plant ingredients is relatively high. J.-P. Corbeau stated that "the Asian cuisine has been one of the molds of the "new cuisine" (Corbeau, 2019).

Like the Poles, the Italians and Portuguese, immigrants coming from the Maghreb have, in a first stage, lived aside the French population. But with the second and third generations of these immigrants, Algerian, Tunisian and Moroccan meals became part of the dishes proposed to French consumers; in 1994, the *cuscus* (*couscous*) became the French people's preferred meal. The latter has become part of the eating habits in the 1990s, particularly thanks to the catering provided to the employees of big companies. North African cuisine enabled French people to discover new spices, such as *ras el-hanout* (in fact a mixture of several spices), curcuma and cumin (caraway), as well as new herbs such as mint and coriander (Corbeau, 2019). To sum up, this second and third generation of migrants have been able to progressively adopt the individualistic and nutritional values of the French society: they are not reluctant to vegan diets and they become more conscious of the health issues of food consumption. For instance, the young women who cook their meals or the household's dishes, adjust their grandmothers' recipes; they reduce the quantities of oil or sugar, they choose to steam the food ingredients, they decrease the size of the portions served, while at the same time emphasizing the healthiness of the Mediterranean cuisine, that has become very fashionable (Chemin, 2019).

In this continuous flow and crossbreeding of all these culinary traditions, including the French one, we are far from the concept of food purity. We have therefore to be careful about associating such concept with that of cultural identity. That is why the United Nations Educational, Scientific and Cultural Organization (UNESCO) decided in 2010 to put on the World's List of Non-Physical Cultural Heritage, not the "French gastronomy" but the "gastronomic meal of the French people" – which, according to UNESCO, proposes a series of recipes "which are enriched constantly." In other words, the cuisine is an alive culture opened to otherness (see p. 254). Françoise Sabban (2012), a study director at the *Ecole des hautes études en sciences sociales* (School of Higher Studies in Social Sciences) has underlined that the press journalists or the media have confused from the outset "the gastronomic or festive meal of the French people" with "the French gastronomy". Such a confusion, in her viewpoint, should exclude a wider idea and use of the word "gastronomic". She indicated that the word "gastronomy" is still influenced by its origins which go back to the 19th century and till the end of the 18th century. That was a period when the gastronomy critic was born. It became very fashionable with writers like Jean Anthelme Brillat-Savarin and even more with writers like Alexandre Balthazar Laurent Grimod de La Reynière. The word "gastronomy" should refer to eating well in a determined social group, which has the means to praise it through the verb. Historically, that has been possible only in a few societies across the world, in a limited environment where culinary practices and the activity of some eating-lovers could generate comments, debates and arguments. Thus, without the speeches and literature devoted to it, the art of eating well does not reach a high level of dissemination and remains within the group of happy eaters who enjoy it (Sabban, 2012).

Therefore, according to F. Sabban, the word "cuisine" is preferable, because it refers to all the practices of production and consumption of foods, as well aw to the knowledge and know-how regarding food preparation and intake. The use of the word cuisine instead of gastronomy has the advantage of not being subjective to a large extent. Regarding the crossbreeding or fusion of cuisines, the word can in fact define all

the cuisines studied that result from mixed practices and tastes; the latter have originated from more or less broad migrations and exchanges. This crossbreeding or fusion should be understood as "a mixture where it is impossible to dissociate the components." Maxime Rodinson (1971), for instance, stated that is was difficult for him to identify with certainty some Moslem features in the European Medieval cuisine; and this albeit there were "similarities" in terms of food ingredients, tastes and cooking, as can be found in the Moslem culinary books and the Christian Medieval ones. The world crossbreeding or fusion would have been useful to define a process, but it would not likely explain the supposed interactions between the know-hows, tastes, practices and products. Finally, F. Sabban (2012) indicates that the confrontation between peoples often starts with their food practices and the exchange of foods. The cuisine (and not the gastronomy) is an operation of mixing ingredients and, often, of their cooking in order to mix them more deeply. It is therefore an excellent example of crossbreeding or fusion. Henceforth the interest of historical research on cuisine, because the latter is, with the food practices, obvious places of encounters of peoples as well as of the implications of these encounters (Sabban, 2012).

Even though some eating habits reflect the current trend of individualism, eating remains in many societies, particularly in developing countries, a social act; it is a moment when people meet around one main course or various dishes, and enjoy the company of each other. This creates a social link and strengthens either the nuclear family or a larger household. On the other hand, the creativity of culinary art is obviously submitted to fashions and trendy situations: from molecular gastronomy to an authentic cuisine relying on basic food ingredients, and also through "new cuisine" and culinary cosmopolitanism. These fashions may be sustainable or last a short time, until they are replaced by another more creative trend.

Prepared meals delivered at home

We have seen in the previous chapters that there is a growing trend to consume precooked meals or ready-to-eat ones. This is explained by the increasing awareness of what people eat, and also by the fact that they have less time to cook their food. For instance, in France, it has been estimated that people spend much less time in their kitchen: from an average of 1 hour and 11 minutes per day in 1986 to 53 minutes in 2010, according to the figures published by the National Institute of Statistics and Economic Studies (INSEE, French acronym). Also in France, there is an amazing increase in the delivery of foodstuffs or restaurant meals at home or at the workplace: +21% in 2018, according to an enquiry carried out in April 2019. Rollot et al. (2019) take, for instance, the case of a teacher who decided not to depend on cooking her own food: she had only to choose among the five weekly recipes offered by one of the numerous enterprises in charge of delivering "ready-cooked" meals. One of these, called Foodette and founded by Olivier Tangopoulos, supplied each month 30,000 meals to 10,000 clients in 2019. Furthermore, it has proposed 900 recipes since its creation and it has been working with more than one hundred producers and craftsmen; the meals were made of at least 60% of organic food. The clients were, to a large extent, couples with or without children and urban dwellers belonging to well-off classes. They were living in Paris or in its suburban areas, as well as in the provinces.

The cost amounted to €5 to €10 per meal and per person, depending on the quantity of food ordered and the recipe. It was more expensive than cooking the food at home, but this was justified according to Etienne Boix, cofounder and executive officer of Quitoque, a French leading enterprise that delivered and sold 120,000 meals a week in 2019; its prices were in the lower end of the cost range. Younes El Hajjami, cofounder in 2016 of the French enterprise Rutabago, partner of the organic-food cooperative Biocoop, said that "the meal-delivery startup becomes a culinary assistant that is part of customers' daily life." He analyzed the mindset of the latter: they are not anymore addicted to the shopping trolley and do not have to answer the repetitive question "what should we eat for dinner; they do not care for the wilting bunch of carrots, while the 'assisted' cook rediscovers the pleasures of sunflower seeds and of homemade pesto or a spring minestrone during a dinner." Rutabago proposes 100% organic meals made of ingredients produced by local farmers, delivered by electric-motor trucks; the meals are vegetarian and the unsold ones are given free of charge to groceries or to help poor people. According to Céline Laisney, executive officer of AlimAvenir, a consultant firm involved in forward-looking food studies, food kits "enable those considering they have no cooking competence or skills – especially the generation of persons aged between 20 and 30 years who have been accustomed to eat industrially-prepared meals – to take it easy", (Rollot et al, 2019).

Drones could also drop your meals at your gate! This is not dystopia. These diet boxes delivered at home do exist and their success is impressive. In the parcels delivered every month or twice a week by human caterers are found cooked meals, dessert creams, cookies for a midday snack, breakfast muesli and soups for dinner. The daily, weekly or monthly calorie inputs are strictly calculated. The slogan of kitchendiet, the first "diet box" on the French market, was: "Let us guide you, we deal with everything". In November 2009, Vincent Guillet founded the company after some experience in the United States. He built a partnership with a medical nutritionist and a chef in order to develop hypocalorie meals to be delivered at home. In March 2010, Bernard Canetti launched the brand "Comme J'aime" and in 2016, its spots praising the products offered to the consumers invaded television screens. "Thanks to the advertisements, we have created the market" explained Mathilde Canetti, executive officer and the founder's daughter. With an annual turnover of €128 million in 2018, 450 employees and almost 400,000 clients since the launching of the brand, the delivered foodkits are quite costly. A cheap version of them (Regime box) was sold in 2013, an organic one (Minibio) has been proposed in January 2019. Smaller companies have been following the example of "Comme J'aime", such as the pioneer Kitchendiet and its lower-cost brand "Dietbon", or the Lagardère group that launched "Mon Panier Minceur" (My Slimming Bag) in 2018 (Rollot et at, 2019).

The success of those diet-food suppliers can be explained by the simplicity of the low-calorie meals, their immediate delivery, the follow-up of the results achieved, the recipes that are enticing and which never use the world "diet". The delivered meals are cooked at high temperatures like preserves and sealed, except those of Kitchendiet, made of fresh pasteurized products. Their taste does not differ from that of meals sold in supermarkets. "We have the same suppliers, but our recipes are proprietary – exclusive – and we offer a complete range," explained Mathilde

Canetti. For a daily cost of €12 to €20, depending on the subscription duration and the range of the selected diet, the clients – mainly the female customers – are generally more than 40 years old and lose a dozen kg per three months. But despite their very fast adoption, these diet boxes are not unanimously praised. For instance, in May 2018, the NGO *60 Millions of Consumers* tore them into pieces: too costly, too restrictive, too rich in salt, sugar, additives and preserving compounds. A diet specialist approached by the NGO magazine stated even: ... "Not a single one (diet) was really satisfactory from the calorie viewpoint." She warned about a loss of muscular mass and an inevitable recovery of body weight once the diet is over. But the companies involved reacted by improving their offer – new products without preservatives, dyes, additives and products from genetically modified organisms or GMOs. Dairy products and fruits are suggested to the consumers in order to reach 1,200 kilocalorie a day. Another suggestion made to those addicted to diet kits was to pause a day per week and to gradually reduce the diet. "We generally help achieving the objective of weight loss, but it is rather complicated to guarantee a long-term result. Between one-fourth and one-third of consumers achieve their objective and are thus satisfied," explained Kitchendiet (Rollot et al., 2019).

This trend is at the opposite of the Slow food movement, as shown by the SlimFast-brand products, which spread through France during the 1990s. Nowadays there is another offer that wants to conquer the market: ready-to-drink powder, bars, but no dietary products. A complete meal, the foodstuffs of which are balanced and healthy; some of them lay emphasis on organic, vegan, lactose or gluten-free preparations. In other words, an offer that meets the needs of "those who cannot spare time to cook their meals, or do not want to do it at all", claimed the French startup Feed on its Facebook page. It started in 2017 and has sold 5 million mealboxes. At the French food-distributor Franprix who was the first to launch the brand, *ca*. 6,000 bars and 10,000 bottles were sold per week (€5 the bottle). The targeted customers are people who make physical exercice on a regular basis and are already accustomed to this kind of food; "all those who have a busy agenda, who try to climb up the promotion scale in their professions, but also those who want to spare time to go to the movies and to enjoy life besides their job," explained the founder of Feed, Anthony Bourbon. Like its competitors, Vitaline or Huel, Feed relies on nutritionists and dieticians to develop its recipes. The composition of each food ingredient – proteins, lipids, sugars, fibres, vitamins, minerals and micronutrients – meets, according to Feed, "33% of the recommended daily intakes" or *ca*. 600 kilocalories. Feed has recently launched a range of light products that bring in *ca*. 300 kilocalories a day; this is close to Vitaline's proposal – between 200 and 400 kilocalories a day – or the Huel's one – 400 kilocalories a day. In terms of savour and quality all these products do not meet unanimous approval (Rollot et al., 2019).

Mergers of food-delivery companies

In the race of meal delivery, the British company Just Eat was purchased by its Dutch rival Takeaway.com on 29 July 2019. Both companies had a stock-exchange value estimated at almost €10 billion, with an annual turnover close to €1 billion. Further to this merger, the new company will be in the hands of Just Eat's shareholders (52%); with

headquarters in Amsterdam, the chief executive officer (CEO) was Jitse Groen, founder and CEO of Takeaway.com. The amount of this merger – £5 billion or €5.5 billion – is a good illustration of investors' interest. The whole sector is being consolidated. According to Sébastien Forest, founder of Allo Resto, a pioneer on the French market, created in 1998 and purchased in 2012 by Just Eat, "on this crazy market, new actors can raise colossal amounts of money, such as Uber Eats and Deliveroo. Just Eat and Takeaway.com have precisely reacted to this competition through their merger." In May 2019, during its last fund raising, the British company Deliveroo harvested €575 million. Including this last operation, the total amount of money collected by the company founded in 2013 was US$1.53 billion or €1.37 billion. Moreover the last operation of fund raising was carried out by Amazon – the giant e-commerce company. Founded by Jeff Bezos, the firm had launched its own delivery service, Amazon Restaurants, in the United Kingdom, before giving up in 2018 (Girard, 2019l).

Amazon was not the only one who wanted to swallow part of the food-delivery market. Uber is present with Uber Eats which made its start in France in 2016 and has decided to invest more than €30 million in order to sponsor the Football Leagues for a period of two years. Confronted with such harsh competition, the food-delivery startups are facing the following dilemma: increase in size or merge with much bigger companies, or disappear. Some pioneering companies have been eliminated, such as the Belgian one Take Eat Easy. The German company Delivery Hero closed down its French subsidiary Foodora during the summer of 2018, before selling its British subsidiary to Just Eat and its main German component to Takeaway.com for €900 million. In the United States, the company DoorDash, which raised US$600 million in May 2019, devotes all its efforts to conquer the American market, while facing the harsh competition of Grubhub or Postmates. To sum up, each food-delivery company strives to adapt its offer so as to reduce its losses, lure new clients and attract restaurants – fast-food restaurants like McDonald's or Starbucks, who are willing to build partnerships. But the business model of these food-delivery companies has a big weakness: the unacceptable legal status of their delivery-men or women. The latter, who often use bicycles, are employed on short contracts and are fighting for their labour rights, whereas they perfectly know that their employers are making big profits (Girard, 2019l).

Halal-food consumption

We have not mentioned the food taboos that prevail in many societies, e.g. Moslems and Jews who ban pork from their diet, Hindus that do not slaughter cows nor eat their meat, those who eat meat only if the domestic animal (e.g. poultry or ruminants) has been slaughtered according to strict religious norms. *Halal*-meat consumption has been widely spreading over recent years among Moslem populations, in their own countries, but also in the Moslem diaspora. For some Moslems who follow verse 5 of the Sourate 5 of the Quran, it is not compulsory to eat *halal* food because food of the People of the Book is acceptable to Moslems. They just have to ban pork from their food. The *halal* market is, according to F. Bergeaud-Blackler (2017), the result of the convergence, during 1980s, between "the economic neoliberal revolution – that imposes to all States a global market economy regulated by supra-state organizations – and "the rise of cultural and religious fundamentalism, integral religions that produce

identity ideologies having no roots and particularly adapted to globalization." F. Bergeaud-Blackler considers that this integral Islam feeds on globalization in order to impose an *islamic way of life*. How the *halal* norm has been invented? In order to deal with *halal* (i.e. making something permissible or justified), we have first to deconstruct what is not permissible or *haram*. The will to control the *halal* market has led to an integrated model which the French sociologist called the "umma model"; the latter moves from a food production that complies with technical norms, especially in the case of meat, to a production under Moslem control, that includes the monitoring of all food products as well as eating habits, based on the principle of absolute purity. Thus, the *halal* market has been progressively extended to finance, business, fashion, health and tourism (see below). At the end of the 2000s, appeared the model of a *sharia-conscious consumer*, that was the new marketing target with a view to developing a *world halal market*, having the potential to involve 1 billion people across the world (Bergeaud-Blackler, 2017; Nizard, 2018).

While the *halal*-world centre moved from Malaysia to Dubai, that gave to the United Arab Emirates – experts in Islamic finance – a new position, that of a pole of the global islamic economy. At the same time, "the utopia of the umma model by the Moslems and not only for the Moslems has been strongly supported by the Organization for Islamic Cooperation, the World Islamic League and islamic associations established in the diaspora." This model excluded the non-Moslems because, according to the *sharia*, they cannot certify the *halal* in all legitimacy. The attempts made to devise a European *halal* norm within the European Commission for Standardization, even with the assistance of Moslem groups, have failed, because the fundamentalist movements are opposed to any kind of non-Moslem regulation control or of the commercial *halal* norm. Regarding the French *halal* market, *halal* production is supported by a large home market – at least more than 4 million Moslems who claimed their faith – as well as by important exports of *halal* meat to countries of the Mediterranean Basin, the Near East and Asia. The *halal* sector is therefore a strategic one for the exports of French meats. Commercial studies have shown that the nearby Islamic butcher's shop is the main purchase space of *halal* meat and products; the large and medium-sized market places are attended by a minority of consumers. The great majority of French Moslems consume *halal* products; according to the results of poll made by the French Institute of Public Opinion (IFOP) in 2009, 60% of French Moslems buy exclusively *halal* products. The enquiries made by F. Bergeaud-Blackler have shown that for the interviewed people a distinct trait of *halal* meat is the slaughter process. In addition, the latter has a moral aspect: more than two-thirds of the interviewed people thought the ritual way of slaughtering animals does not make them suffer. This obviously contradicts the message of some veterinarian and animal-welfare organizations (Bergeaud-Blackler, 2017; Nizard, 2018).

The certification of *halal* meats involves the official appointment of the slaughterer, by one of the three mosks authorized by the state (Paris, Evry and Lyon); there also exist "*halal* certification agencies" which claim they are independent. These agencies, which are most often associations created in compliance with the 1901 law (as cultural associations), do not show a full transparency regarding the cost of the service billed to the producers. One of the central issues raised by the *halal* certification is that

of slaughtering the animals with or without dizziness. Nowadays, in France, most of the religious authorities had adopted the most rigoristic approaches to a ritual slaughter carried out and controlled by Moslems. Opponents of this position are very rare; F. Bergeaud-Blackler quoted the statement of an Islamic scholar, Ghaleb Bencheikh, that denounced "an excessive normality" applied to food and clothing. By the mid-2000s, the scandals about "false *halal*" and the "*halal* mafia" have triggered a movement among religious activists aimed at defending the rights of "the Moslem consumer" and, subsequently, at promoting these rights. This has contributed to "the promotion of universal Islamic values in the economic and social fields, including education, food, health, business, work, culture and leisure" (Bergeaud-Blackler, 2017; Nizard, 2018).

After having analyzed what is at stake in the *halal* process, F. Bergeaud-Blackler tried to decipher the controversial debates in the public arena on the ritual slaughter of animals and on *halal* food in public institutions and companies. Ritual slaughter without dizziness has raised indignation in part of the public because of the increasing concern about animal welfare. Also "eating *halal*" in schools or penitentiaries and in companies, was another focus of the French sociologist's analysis. She quoted the claims of those who want a strictly *halal* food, because they feared contamination, as well as of those who are opposed to any compromise – e.g. vegetarian meals or fish dishes. She also denounced the error made by many political executives who proposed to grant a recognition and funding to those they considered as "moderate" and bulwarks against the trend of radicalization. She suggested that they should not interfere with religious affairs, of which the *halal* market is part, so as to respect secularity and its principles (Bergeaud-Blackler, 2017; Nizard, 2018).

An illustration of the worldwide expansion of *halal*-food consumption is the rise of *halal* tourism. Since 2016, the number of Moslem travelers has grown nearly 30%, and a recent joint study by Mastercard and Crescent Rating, a research group that tracks *halal*-friendly travel, projected that over the next decade, that sector's contribution to the global economy will jump to US$300 billion from US$180 billion (certainly less due to the Covid-19 pandemic). With a population that is disproportionately young, educated and upwardly mobile, Moslems are one of the fastest-growing demographics on the global scene tourism. There is no pork on the hotel-dinner menus, obviously. There are flights with no alcohol on the drink carts, resorts with separate swimming pools for mean and women and daily itineraries with break times for the daily calls to prayer. There is a *Halal Travel Guide*, an online platform offering tips, recommendations and curated itineraries for Moslem travelers. In October 2018, at ITB Asia, a travel show in Singapore, organizers partnered with two *halal*-travel authorities, Crescent Rating and *Halal* Trip, to offer specialized panel discussions and showcases targeting the estimated 156 million Moslems who will book travel by 2020. Much of the discussion concerned matters relating to food, i.e. good quality *halal* food (Kamin, 2019).

PART TWO

FOOD INGREDIENTS

CONTENTS

FIBERS MATTER

Why do we need fiber-rich foods?

A diet of fiber-rich foods, such as fruit and vegetables, reduces the risk of developing diabetes, heart disease and arthritis. But while these benefits are clear, it is not so clear *why* fiber is so important. "It is an easy question to ask and a hard one to really answer," stated Fredrick Bäckhed, of the Wallenberg Laboratory and Sahlgrenska Center for Cardiovascular and Metabolic Research, Department of Molecular and Clinical Medicine, Institute of Medicine, University of Gothenburg, Sweden, and of the Novo Nordisk Foundation Center for Basic Metabolic Research, Section for Metabolic Receptology and Enteroendocrinology, Faculty of Health Sciences, University of Copenhagen, Denmark. Makki et al., and Bäckhed (2018) published a paper on the impact of dietary fiber on gut microbiota in host health and disease. Human gut harbours trillions of microbes representing all kingdoms of life that are essential for host development and physiology. This "gut microbiota" constitutes a complex community that interacts with each other and with the host to modulate biological processes essential for health. In their 2018 paper, the researchers from Sweden, Denmark and also Canada focused their attention on the role of dietary fibers, which interact directly with gut microbes and lead to the production of key metabolites such as short-chain fatty acids. They concluded their publication by stating that dietary fibers can be considered key ancestral compounds that preserve gut ecology, especially regulating macronutrients and host physiology. Hippocrates' notion "Let food be thy medicine and medicine be thy food" remains highly relevant millennia later, but requires consideration of how diet can be used for modulation of gut microbial ecology to promote health. To digest food, we need to break down its molecules through many enzymatic processes occurring in our digestive tract. Those molecular fragments then pass through the gut wall and are absorbed. But our bodies make a limited range of enzymes, so that we cannot breakdown many of the tough compounds in plants. The phrase "dietary fiber" refers to those indigestible molecules. But they are indigestible only to us. The gut is coated with a layer of mucus, which harbours hundreds of species of bacteria, part of the human microbiome. Some of these microbes carry the enzymes needed to break down various kinds of dietary fiber (Zimmer, 2018).

Hannah D. Holscher of the Department of Food Science and Human Nutrition and Division of Nutritional Sciences, University of Illinois, Urbana, Illinois, has shown that human alimentary enzymes are not able to digest most complex carbohydrates and plant polysaccharides that are part of the ingested fibers (e.g. in fruit and vegetables). Instead, these polysaccharides are metabolized by microbes which generate short-chain

fatty acids (SCFAs), including acetate, propionate and butyrate. H.D. Holscher (2017) reviews in her article the current knowledge of the impact of fiber on the composition and metabolic function of the human gastrointestinal microbiota, including the effects of physiochemical properties of complex carbohydrates and the phenotypic responses related to the composition of the human microbiota. Bäckhed and his colleagues surveyed the microbiota in mice as they were switched from fiber-rich food to a low-fiber diet. The scientists focused on the diversity of species that make up the mouse's gut microbiota. Shifting the animals to a low-fiber diet had a dramatic effect: they found many common species became rare, and rare species became common. Along with changes in the microbiota, both research teams also observed rapid changes in the mice themselves. Their intestines became smaller, with a thinner mucus layer. As a result, bacteria wound up much closer to the intestinal wall, and that encroachment triggered an immune reaction. After a few days on the low-fiber diet, mouse intestines developed chronic inflammation.

Bäckhed and his colleagues also fed another group of rodents the high-fat menu, along with a modest dose of inulin, a fructose-polysaccharide. The mucus layer in their guts was healthier than in mice that did not get the polysaccharide and therefore intestinal bacteria were kept at a safer distance from their intestinal wall. With a diet containing inulin, but at a much higher dose, the improvements were even more dramatic, despite a high-fat diet, the mice had healthy populations of bacteria in their guts, their intestines were closer to normal, and they put on less weight One way that fiber benefits health is by giving us, indirectly, another source of food. Once bacteria have harvested the energy in dietary fiber, they cast off the fragments as waste. That waste – in the form of short-chain fatty acids (SCFAs) – is absorbed by intestinal cells, which use it as fuel (Zimmer, 2018). But the gut's microbes do more than just make energy. They also send messages. Intestinal cells rely on chemical signals from the bacteria to work properly: the cells respond to the signals by multiplying and making a healthy supply of mucus. They also release bacteria-killing molecules. By generating these responses, gut bacteria help maintain a good coexistence with the immune system. While some species of gut bacteria feed directly on dietary fiber, they probably support other species that feed on their wastes. A number of species in this ecosystem – all of it built on fiber – may interact with our guts. Going on low-fiber diet disturbs this relationship. The species that depend on dietary fiber starve, as do the other species that depend on them. Some species may switch to feeding on the host's own mucus. With less fuel, intestinal cells grow more slowly. And without a steady stream of chemical signals from bacteria, the cells slow their production of mucus and bacteria-killing poisons. As a result, bacteria edge closer to the intestinal wall, and the immune system is particularly disturbed (Zimmer, 2018).

Inflammation can help fight infections, but if it becomes chronic, it can harm our bodies. Among other things, chronic inflammation may interfere with how the body uses the calories in food, storing more of them as fat rather than burning it for energy. Hannah D. Holscher, stated that the results on mice needed to be put to the test in humans. But it is much harder to carry out such studies on people. In her own laboratory, Holscher and her colleagues provided volunteers with all their meals for two weeks. She could then give more of her volunteers an extra source of fiber – such as walnuts – and look

for changes in both their microbiota and their levels of inflammation. Holscher and other researchers hope that they will learn enough about how fiber influences the microbiota to use it as a way to treat disorders. Lowering inflammation with fiber may also help in the treatment of immune disorders such as inflammatory bowel disease (Holscher, 2017).

Production of "high-tech" salad in Japan

In Kyoto – the old imperial city of Japan – *kyoyasai* have been cultivated for more than 2,500 years. These unique vegetables that include the *shôgoin daikon* (or *shôgoin* raddish), the *kamonasu* (*kamo* eggplant), the *kintoki ninjin* (*kintoki* carrot), among others, have a very fine flavour and taste, as well as an awkward shape. They are produced in a traditional way around the former Japan's capital. Also in the neighbouring mountains tasteful *maïtake* mushrooms could be found; they were formerly collected in the wild when woodcutters were gathering firewood. But besides this traditional agriculture, there is a "lettuce factory" that belongs to the Spread company, ubicated in Kameoka – a suburb of Kyoto. It is a factory, a literal translation of the Japanese word *kojo*, that looks like a pharmaceutical plant (Nishimura, 2017). This factory has been working for more than ten years, 24 hours a day, and it produces several salad varieties (e.g. Roman, oak-life salads). They are cultivated upon four floors, with several shelves for each level, i.e. on more than 25,000 m^2. They are grown on a liquid nutrient solution, i.e. without a soil support. About 21,000 salads are cut off along the year, packed and dispatched to 2,200 shops in the Kansai region (to the west) or in the Kanto region (eastwards in the Tokyo area). The dripping nutrient solution consists of several mineral compounds diluted in distilled water. The plants are exposed to artificial light during the day and they are kept in the dark at night. For the consumers, they bring the following advantages: they have not been sprayed with pesticides, they have no insect parasites, they have not an earthy taste, their savour and price are the same the yearlong. The only drawback is that this fixed price is "on average 20% higher than that of conventionally cultivated salad" (Nishimura, 2017).

The salads grown under artificial light can be collected after 43 days of growth instead of *ca*. 60 days in the case of conventionally cultivated salads. After the Fukushima nuclear disaster in 2011, radioactive contamination resulted in making Japanese consumers very careful about eating vegetables cultivated in soils that may have been polluted. As a result, these vegetables grown in factories, well protected from the local environment and without a soil support, were socially accepted by the Japanese people because they were safer. In fact, Shinji Inada had started to believe in this production process long before the Fukushima disaster. This forty-year-old man who had started his career as a commercial employee of the Coca-Cola group, created in 2001 the Trade Group company – with a €200-million annual turnover –, aiming at building up a logistic system for transporting fresh vegetables and supplying high-quality produce the yearlong. In 2006, he founded Spread with the same aim and he reached economic profitability in seven years; quite an achievement, when three-quarters of the almost 200 plants, that produce vegetables in a close system and under artificial light in Japan, were economically non-profitable according to the agronomist Toyoki Kozai, president of the Japanese Association of Plant Factories (Nishimura, 2017).

The Kameoka (Kyoto) plant owned by Spread has put in place a strict safety policy: only do enter the plant those employees who have been "decontaminated", using an air shower; they wear white coats on their whole bodies and look like busy laboratory assistants. Temperature of the whole plant is maintained at about 23°C – an important factor because a difference of 4° to 6°C tends to develop between the upper shelves and the lower ones, and that may lead to an uneven growth of the lettuce plants. Another first-class, higher-yielding plant has been built south of Kyoto. It will produce 30,000 salad units per day, and with only half of the people employed in the Spread-Kameoka plant. Seed sowing, water spraying, monitoring of plant growth and cropping will be carried out by machines guided by artificial intelligence. Softwares are designed to record in real time the nutrients-and-water needs of the plants at their various growth stages, so as to supply the optimum volumes at the right time. In other words, 80% of these tasks are carried out by robots, or rather by "manipulation arms", as stated by Kiyoka Morita, Spread's spokesman. These new technologies aimed to reduce by ten days the maturation period of lettuce plants, down to 33 days. The water used to irrigate the plants is recycled (98%), using a system for recovering air humidity, while many kinds of sensors and a sophisticated system of plant-growth monitors are set up. The investment reached €18 million and the annual production of the plant was *ca*. 11 million salads. The objective of this new factory will be to make it a "mother plant", the model of which could be licensed in Japan and elsewhere across the world. Within five years, Spread aimed to produce 500,000 lettuce plants per day (Nishimura, 2017).

Spread is not the only Japanese company who made the decision to cultivate salads in high-tech factories. A number of high-tech companies have transformed some of their plants producing hardware or software components into vegetable factories. The Panasonic group as well as Fujitsu, respectively an electronic equipment company and a supplier of information equipment and services, have their own vegetable-growing plants. Panasonic, for instance, proposes an on-line assistance to conventional farmers in order to provide them with remote recommendations in order to optimize their lettuce crops and to reduce energy consumption. Masai Matsubara, the agronomist in-chief of Panasonic, even stated that "the taste could be controlled through monitoring light exposure." Panasonic's salad factory, based in Fukushima, produces 2,000 salads per day with a staff of only eight persons (Nishimura, 2017).

This Japanese lettuce production can save a lot of water: only 0.11 litre of water is used to grow one salad plant, instead of 10.73 litres in conventional farming, due to the recycling of 98% of the water consumed. The process could be exported, for instance, to the United States. Thus AeroFarms, partly funded by Goldman Sachs bank and the insurance company Prudential, produces its salads and cabbages in its Newark factory, New Jersey. These plants, because of their capacity of saving a lot of water, could be of special interest to drought-stricken countries. But Kiyoka Morita highlighted that "their ambition is to demonstrate that there is a forward-looking agriculture, and thus attract younger people to this new agricultural venture." It is true that in Japan, the average age of farmers – whose number is decreasing progressively – is *ca*. 66 years and their farms are often too small to be profitable. Therefore, Japan can partly rely on this *mouse click saibai* (mouse-clicked agriculture) in order to improve its food self-sufficiency – *ca*. 40%, one of the lowest rates in developed countries –, while keeping its reputation of a technology-leading country (Nishimura, 2017).

Urban agriculture and fresh-produce supply: promotion of circular economy

Urban farming is rapidly growing in places like New York, Paris, Shanghai, Singapore and Tel Aviv, for good reasons. Clinton et al. (2018) have introduced a quantitative framework to assess global aggregate ecosystem services from existing vegetation in cities and an intensive urban agriculture adoption scenario based on data-driven estimates of urban morphology and vacant land. The researchers have analyzed global population, urban, meteorological, terrain, and Food and Agriculture Organization (FAO) of the United Nations' datasets in Google Earth Engine to derive global scale estimates, aggregated by country, of services provided by urban agriculture. They estimated the value of four ecosystem services provided by existing vegetation in urban areas to be of the order of US$33 billion annually. They projected potential annual food production of 100-180 million tons, energy savings ranging from 14 to 15 billion kilowatt hours, nitrogen sequestration between 100,000 and 170,000 tons, and avoided storm-water runoff between 45 and 57 billion cubic meters annually. In addition, they estimated that food production, nitrogen fixation, energy savings, pollination, climate regulation, soil formation and biological control of pests could be worth as much as US$80-160 billion annually in a scenario of intense urban agriculture implementation. These estimates represented the first effort to consistently quantify these incentives globally, and highlight the relative spatial importance of built environments to act as change agents that alleviate mounting concerns associated with global environmental change and unsustainable development (Clinton et al. 2018). Urban agriculture could also help increase food security and reduce food waste, stated Matei Georgescu, one of the study's authors and an associate professor of geographical sciences and urban planning at the University of Arizona. For instance, Lufa Farms in Montreal, Quebec, Canada, opened a commercial rooftop farm in 2011, and since then it has been doubling the amount of food it produced every two years. It now grows *ca*. 50 varieties of veggies in three hydroponic rooftop farms that generate "virtually no waste." That is because it only harvests by order and sells products only in Montreal. In addition, Lufa saves energy by warming its farms with the excess of heat emanating from the buildings below, capture rain for irrigation, packages products in compostable plastic and relies on 25 electric cars to deliver some of the 17,000 baskets it sells online every week (Garcia, 2019a).

Lauren Rathmell, a trained biochemist and co-founder of Lufa Farms, stated that the company was not using a single synthetic pesticide. Lufa turned its greenhouses into high-tech living ecosystems that host dozens of insect species including "good bugs" like parasitic wasps, ladybugs and predatory mites to keep pests under control. As a result, commented L. Rathmell, Lufa demonstrated a commercially viable way to supply urbanites with greens grown sustainably in rooftop greenhouses – a system that is particularly suitable for cold-weather cities with short growing seasons. Lufa estimated that by converting 19 rooftops of average-sized shopping centres it would be able to supply all of Montreal – which has a population of *ca*. 1.8 million people – with sustainably grown veggies. While Lufa has considered spreading to the Northeast United States, like other companies in the circular economy sphere, it believed that "slow growth" was the best way to be faithful to its principles. "What we are trying to build is something that can last. Something that can have an impact on access to

quality, fresh produce in cities, where more and more people are. Montreal is the test bed but we see this as a multigenerational endeavour," L. Rathmell stated (Garcia, 2019a).

Another example not very far from urban farming and circular economy in the urban environment, is that of Bubbly Dynamics, the organization that in 2010 converted a former meat-packing facility in Chicago into a hub for local food businesses. A large digester was built and it was expected to turn organic waste into compost, biogas and a nutrient-rich liquid in which to grow algae. This digester will help Bubbly Dynamics implement a circular economy, a model that could help fight climate change by feeding a rapidly growing urban population with food grown locally using organic methods, according to experts. This closed-loop system would create little to no waste because materials would be reused, shared, repaired and refurbished. Proponents of the circular model argue that cooperation among various groups in the food-production system can significantly reduce energy consumption and waste. Next to the digester, The Plant is a 93,500-square-foot "living food laboratory", home of *ca*. 20 food businesses – including a Kombucha brewery, a coffee roaster, a chocolate maker and a vegan-ice-cream maker. The Plant is among the global pioneers of this concept of urban farming. There, the indoor farms are irrigated with rainwater, and some of the energy is generated from solar panels. The spent grain from the Whiner Beer Company, the building's largest tenant, is mixed with wood chips and horse manure to produce roughly 20,000 pound of compost a month, and some of the carbon dioxide from the fermenting process is used to stimulate the growth of plants and algae. "At its heart, The Plant is primarily a tool to fight climate change," stated John Edel, founder and director of Bubbly Dynamics. By reusing organic waste instead of letting it rot in a landfill, this facility keeps methane, a powerful greenhouse-effect gas, away from the atmosphere. "It has many other benefits to pass around, like providing economies of scale to small businesses so that they can compete with larger ones," he added (Garcia, 2019a).

Some of the collaborations that have allowed The Plant's low-environment footprint have been encouraged by Plant Chicago, a nonprofit that promotes circular economy practices. But The Plant, a gigantic food laboratory, is also about science and technological innovations. Researchers at the mycology laboratory are trying to grow mushrooms on the spent grain from the microbrewery and Backyard Fresh Farms is developing robots controlled by artificial intelligence to tend to its plants. Back of Yards Algae Sciences wants to use algae to produce protein-rich food as an alternative to meat. This Plant's newest tenant stated that algae could be the bedrock of a sustainable, largely plant-based food industry. The founder of Back of Yards Algae Sciences explained: In this former meat-packaging facility, "the meat of hundreds of millions of pigs was probably processed in here. And soon we will be able to make a burger that is 100% algae-based and cruelty-free" (Garcia, 2019a).

SOYBEANS

Figures

Soybeans – *Glycine max*, a member of the wide-ranging family of legumes Papilionaceae – has become the world's most important bean, with a global acreage of *ca*. 385,000 square miles in 2017. The amount projected for the United States' soy production in 2018 was 120 million tons, accounting for nearly half the global market and making it the largest producer, followed closely by Brazil. In the United States soybeans are grown in the upper Midwest. Illinois topped the list in 2017 at more than 611 million bushels. Iowa, Minnesota, North Dakota and Nebraska made up the remaining top five States. China which is unable to produce enough animal feed (soybean meal) itself, consumes two-thirds of the world's product, making it the largest importer. China spent US$34 billion on soybeans. It has been estimated that *ca*. 700 million pigs are fed in China with soybean meal (*Newsweek*, 25 May 2018, p. 41).

The global soybean derivatives market has been estimated at US$255 billion in 2020. Three-quarters of the worldwide crop is used for animal feed, bringing oil and proteins; 6% of soybeans are consumed by humans. In one cup of soybeans, there are 68 g of protein. Chicken, by comparison, contains 38 g per cup. The irony: vegans favour a food that is a prime source of feed for the animals' meat-eaters love! Four thousand square miles have been cleared in the Brazilian Amazon territory for soybean fields between 2001 and 2006, before the Soy Moratorium – an agreement by major purchasers not to buy soybeans grown on newly deforested land (*Newsweek*, 25 May 2018, p. 41). Since then the political situation has changed and more forest lands are converted into cattle ranches and soybean farms.

By the year 2016, *ca*. 10,000 kg of soybeans were produced per second across the world. In 50 years, global soybean production has been multiplied by 10 thanks to the outputs of the United States, Brazil and Argentina. Although 70% of soybean production is derived from genetically modified plants, this legume species enjoys a good reputation in the global human diet: it has the highest protein content among oil-seed species, as well as the highest content of oil among protein-seed species; it has no gluten, nor lactose. The legume or its derivatives are found, for instance, in hamburgers or chicken wings which are supplied by intensive livestock husbandry. Also soy lecithin, a natural plant emulsifier, is present in many agrifood products, from mayonnaise to chocolate bars.

Indonesian tempeh

Fermented soybean products have been increasingly introduced into the Western diets, through vegetarian meals and Japanese cuisine. Thus the large consumption of *sushi* in the Western eating places and restaurants made the soy (soya) sauce very familiar. But for a large proportion of the consumers, *tofu* was not a clearly identified culinary meal. The *tofu*'s main characteristic is the lack of taste, but for the Japanese consumers it has a distinct savour. By contrast to the *tofu*, which is the result of the clotting of soy milk, using *nigari* (Japanese salt) or magnesium chloride or vinegar and even lime juice, *tempeh* is a fermented product. Its manufacture includes, firstly, taking off the thin envelope of the selected beans; then, the beans are soaked in water for one or two days and washed several times, before being boiled during one hour to one hour and half. After taking off the scum and water, the paste is fermented by a mould, *Rhizopus oligosporus*; there are several strains of the same mould which give distinct flavours to the end product. Fermentation lasts two or three days at 30°C-33°C; it is monitored continuously like the fermentation of grape juice, till the formation of a layer of mycelium, thick enough in order to stop the process by dropping the temperature to 4°C. The fermented paste is pressed and divided into 200-g rectangles. The latter are conserved in a vacuum space with a fixed date of consumption: 15 days for the fresh product and six months for the frozen one. "In Indonesia, tempeh is packed in a banana leaf and consumed rapidly." It is a living product and even in a vacuum space its transformation continues and gives different savours and flavours: when it is still young it tastes like hazelnut, but when it is more mature it has mould aromas. In France, in a place near Langon, in the Gironde area (not very far from Bordeaux), Christophe Nurlailli produces a dozen kg of tempeh every week: labelled as Biosegar, it is sold in organic-food shops (Géné, 2016a).

ALGAE AND MUSHROOMS

The global production of macroalgae – cropped and used for millennia in Asia – has been estimated at 25 million tons in 2013, from 2 million tons in 1970, by the Food and Agriculture Organization of the United Nations (FAO). *Ca*. 90% of this production is derived from algaculture. Europe's production is a modest 320,000 tons, including 72,000 tons from France; these are wild macroalgae harvested on the seashore and in shallow waters. While the Asian countries use macroalgae as food – *ca*. 14 kg per inhabitant per year in South Korea, ahead of China and Japan –, European countries use them in the manufacture of cosmetics, in agriculture or the agrifood industry (Géné, 2016d).

In France, in Brettany, along the 50 km of coasts around the town of Roscoff, 800 species and varieties of macroalgae have been identified. They make up the largest macroalgal acreage in Europe, due to the quality of the seawater – at the border of temperate, cold and warm waters – and the transparency of the sea layer down to 50 m of depth. Régine Quéva, a former school teacher and a passionate environmentalist, who founded the club of Algae Snackers (*Croqueuses d'algues*), quoted by J.P. Géné (2016d), explained that "the brown macroalga *Laminaria digitata* had been harvested to make loaves of soda, due to its richness in sodium; soda was used in the manufacture of glass, lowering its fusion point. When Nicolas Leblanc (1742-1806) developed an extraction process of sodium carbonate from sea salt, the use of macroalgae was abandoned. In the food industry *Laminaria digitata* is used in the manufacture of gelifying products such as agar, carraghenans, alginate, called E400 to E407, and present in ice creams, industrial pastries or delicatessen. Whey they are raw or cooked, macroalgae can be consumed as thin flakes or leaves; they have a very low-calorie content (no fats), and they contain mineral salts, iodine, iron, proteins, vitamins, fibers and several micronutrients. In addition, they can flatly replace sodium chloride. But macroalgae, like some plant species, can concentrate toxic compounds, such as arsenium, cadmium and mercury. It is therefore recommended to consume *ca*. 20 authorized species, such as the sea lettuce, *Fucus* sp., *kombu*, *nori* or *wakame*. These macroalgae are seldom found in the markets, but they are sold in organic-food shops; they are not part of the main dishes, except perhaps the sea lettuce and a few species mixed in salads or with ground meat. The *nori* macroalga, the most widely consumed, is used to package *makis*, while the leaf of *wakame* floats in all *miso* soups. The *kombu* is a compulsory ingredient of *dashi* – a broth containing dried bonito – that is the basis of many culinary recipes (Géné, 2016d).

In Roscoff, Brettany, several businessmen, who are conscious of the future of macroalgae, have started to set up their headquarters near the ferry terminals of that town. Thus, Henri Courtois has been visiting the organic-product markets in Paris in order to demonstrate the advantages of these sea macroalgae, before founding the company Bord à Bord; the latter manufactures products from fresh macroalgae harvested on the sea shore and processed locally: marinated *nori*, algal tartare, mustard made of fresh algae, salted macroalgae, *tsukudani* of caramelized *kombu*, which are condiments or snacks. The success of macroalgae supplied by professional harvesters has enticed the latter to move to growing macroalgae in order to meet the foreseen needs. In fact, they are cultured on vertical ropes like mussels, thereafter they are harvested when they reach the size of thick bunches (Géné, 2016d).

A black truffle that saved a Spanish village

In 2002, Sarrion, a small village of the Aragon region of Spain (northeast) with a population of one thousand inhabitants, which made a bet on the cultivation of the black truffle (*Tuber melanosporum)*. This village is ubicated in a sub-mountainous zone which crosses the northern part of the Iberian Peninsula, from east to west, and covers several autonomous regions, Aragon, Catalunya, Castilla and Valencia. It is a landscape of hills and plateaux partly covered with holm oaks (ilex). Francisco Burillo, a professor of prehistory at the University of Teruel (Aragon), has found a nickname for this region: "Spanish Lapland". Which are the similarities between this region and the extreme part of Finland? First, the lowest human densities existing in the European Union. In this region of *ca*. 65,000 km^2, twice the area of Belgium, are living only less than 500,000 people – or a human density of 7.3 inhabitants per km^2, i.e. only thrice that of Lapland. Second, the same Francisco Burillo uses the word: "demothanasia", i.e. demographic euthanasia: not only the human density is very low, but this region has also the highest rate of ageing in the European Union (Piquer, 2017).

But there are those, like Juan Carlos Escuder, who do not like to compare this region to Lapland and prefer to take the example of the Scottish Highlands where "since the 1960s measures have been taken to combat depopulation." This entrepreneur, and others, have strived to unlock the region through the improvement of transport means, the refurbishing of houses, and incentives for companies to move in and create jobs. Thus, Sarrion has become the Spanish capital of the black truffle. Low-fertility soils have made the wealth of Sarrion, because at the beginning of the 2000s many farmers started to plant truffle oaks on these soils – in a sub-mountainuous calcareous, dry and cold scrubland. To that end, they adopted and improved French and Italian techniques for inducing the mycorrhization of the oak's root system and the subsequent development of the truffle, explained Juan María Estrada, one of the owners of Inotruf, the largest "nursery" of Sarrion, that sells *ca*.130,000 stocks of truffle oak per year (Piquer, 2017).

Ca. 6,000 hectares have been planted on the arid hills of the Gudar-Javalambre district, where Sarrion is ubicated. During five months, from November to March, *ca*. 38 tons of black truffle are harvested – a very nice harvest for the 8,000 inhabitants who were doomed to leave their countryside. In fact, the black-truffle production has

created many jobs, such as agricultural-work managers, suppliers of machinery and nursery workers; but it also empowered some natives of Sarrion to create their own business, e.g. canning activities to preserve the truffle, or shops selling truffles and various derivatives of their "terroir". Some of these businesses are selling their produce across the world, e.g. preserves, flavoured products and even frozen truffles. The black truffle is selling very well: between €600 and €800 the kilogram – a very good and unexpected revenue for this region. It seems that in Sarrion rural exodus is decreasing very significantly, the local school has opened new classes and there is therefore a new hope for the locals; although one should bear mind that it takes up to ten years for a planted oak to give its first truffles. Finally, this development has made Spain the world's leading producer of the black truffle, ahead of France. In 2016, the French production amounted to 30 tons, while that of the grey truffle – also called truffle from Burgundy – reached 600 tons. *Ca*. 80% of the Spanish production is sold to French wholesale dealers and manufacturers of canned truffles. The fresh produce is sold on Saturdays at the village's market place and, two days later, it can be found in renowned restaurants in Paris or New York. The Spaniards, especially the Association of Truffle Producers of Teruel – a town ubicated on the fringe of the region of Sarrion –, aimed to launch a marketing campaign with a view to creating an *appellation d'origine contrôlée* – an official certification guaranteeing the quality of the product and its traceability to a specific production site – in order to protect this luxury food item (Piquer, 2017).

SOME FRUITS

Citrus fruits and Italian history

Helena Attlee's book *The Land Where Lemons Grow* was featured as BBC Radio 4's "Book of the Week" and won the Guild of Food Writers "Food Book of the Year" in 2015 (Attlee, 2015). It is the sweeping story of Italy's cultural history through the history of its citrus crops. The author stated that the research for the book took her from a marmalade kitchen in the orange groves of eastern Sicily to the bloodied streets of Irvea during the Battle of Oranges. The book emerging from H. Attlee's journeys combines history and economics with recipes, art and poetry to take the reader on a travel through Italy's cultural, moral and political past. For instance, traveling in winter along the coast of Genoa, where the mild climate is favourable to the cultivation of citrus, she requested in one of the numerous bars of the harbour city a *campari* with orange juice: the waiter who did not understand the Italian accent of the British tourist, after a while said loudly: "*Ah! a garibaldi*." He then brought a red beverage, similar to the colour of shirts worn by the one tousand volunteers who crossed Italy, under the leadership of the revolutionary Garibaldi. In the *garibaldi* beverage, named after the Italian leader, the bloody orange which the bartender pressed with his hands, was grown on the slopes of Mount Etna, the still active volcano of Sicily. While Garibaldi was striving to conquer these orange orchards of Catania and include them in the new Italy, at the other end of the country Lombardia, Gaspare Campari invented a liquor the ingredient of which was an extract of *chinotto*, a very acid citrus variety, grown in Liguria, the province of Genoa. Half of a slice of fresh orange was added to the mixture. H. Attlee started to understand in this bar terrace, in Genoa, that the citrus fruits were a red thread helping to weave the exciting Italian history. The cultivation and expansion of citrus species, varieties and fruits is the result of crossed pollinations, similar to the history of this Mediterranean country, which acknowledged invasions, migrations and economic interactions (Guimón, 2017).

"There are many examples of how the citrus species and varieties have changed the history of Italy and the rest the world. It is wonderful to see how they are surrounded by an incredible blessing, just like having a passion for gold." While following the track of citrus, it is possible to detect the origin of the Mafia. In 1747, a medical doctor of the British navy, named James Lind, tried a medical treatment using lemon juice against scurvy, which was a thriving illness among sailors deprived of vitamin C – from fresh vegetables or fruit – during their long sea journey. The Royal Navy had to supply its ships with large quantities of lemon juice in order to protect the sailors against the disease. When Admiral Nelson conquered Malta in 1798, he entrusted this island as

well as Sicily with the supply of lemon juice. This has resulted in an important economic boom in the Gold Watershed that extends through the plains located between Palermo and the sea. This trade attracted all kinds of highwaymen, thieves, lawyers and politicians who, drawn by their greed, set up among the lemon-orchard owners the organization that was to become the Mafia. H. Attlee explained that this "happened along with a change in the political regime, when the Bourbons left the island …" "In this wonderful Sicilian land was born the system of intimidation. The rural landscape helped illegal trade, with a safe haven for the Mafiosi" along the high walls that protected the lemon orchards against the wind (Attlee, 2015).

Italian citrus fruits were sometimes the raw materials of products of incredible beauty in undreamt-of places. Thus the Cologne water bears the name of the German town to which has migrated Giovanni Maria Farina – a teenager from Piemonte; he was a supergifted nose of an old family of scent makers. In 1708, he invented this perfume the basis of which was the bergamot, a citrus variety from Calabria, resulting from the cross-pollination – that occurred by sheer luck – between a lemon tree and a bitter-orange tree. The Cologne water was the dominant perfume on the Western market for 300 years, a success just equal to that of bergamot that also gives its aroma to one of the most popular teas of the world, the Earl Grey variety. Helena Attlee, pursuing her "tracking down" of the citrus family, discovered that during the Italian Renaissance (*Rinacimiento*) the bitter orange was like the "ketchup" of today. It was part of all meal recipes, that included the tortoise pie or the cow's udders filled with milk, a delightful meal, which the cook Bartolomeo Sappi used to prepare for Pope Pio V. Having studied the Italian language and having lived in Florence, like many British teenagers used to do, she became an expert, with her husband, a photographer, of Italian gardens. She used to organize travels for British tourists to visit these gardens. Later on, her curiosity focused on citrus trees planted in large pots and present in these Renaissance gardens. "These trees had, according to her observations, fruits with very unusual or odd shapes; there were even different kinds of fruits on the same tree. She discovered that these plants were part of the so-called curiosity cabinets, which were the predecessors of the natural history museums. Some of these plants were more than 300 years old and she realized that she had to do not just with a lemon tree, but with a cultural subject" (Attlee, 2015).

Still in Italy, one should mention the highly-prized lemons harvested by hand on the trees growing on the cliffs along the Amalfi coast, between Naples and Salerno, in Southern Italy and facing the Thyrrhenian Sea. The lemons, in addition to their juice, are used in the preparation of a sweet liquor, the *limoncello*, the flavour of which is due to the lemon peels macerated in the liquor. The Mediterranean countries have a wide range of citrus species and varieties, most of them imported from the Far East (China and Japan) onboard the ships of the countries that explored and even occupied these regions. Most of the plantations are generally irrigated, and agronomic research in some well-known experimental stations has even widened the existing range of citrus varieties. For instance, Robert Fortune (1812-1880), a British renowned botanist and explorer who travelled a lot across Asia and introduced the tea in India, discovered the *kumquat*, a small citrus shrub that bears his name, *Fortunella*. Robert Fortune was a special envoy of the Royal Horticultural Society of London. The *kumquat*, which

has been present in the Mediterranean Basin since 1848, was not easily accepted by Mediterranean consumers, while it had an enormous success in Florida. The *kumquat* fruits have a small size, a red-orange colour and a flesh with little juice and rather large pips; it is the only citrus fruit that can be eaten with its peel. Two species of *kumquat* are cultivated in Corsica, *Fortunella japonica* and *Fortunella margarita*, and they are used to make excellent jams. The *kumquat* is commercialized between the months of October and March; it is a healthy fruit, with a lot of vitamins A and C, magnesium, polyphenols and fibers (Géné, 2012; Labro, 2019a).

Avocadoes

Mexico is the cradle of avocado, the seeds of which have been found in a cave of the region of Coxcatlán, Puebla (*ca*. 200 km from Mexico), amidst human bones whose age has been estimated at more than 8,000 years. When America was discovered by the Spaniards it has been reported that the avocado tree (wild or cultivated) was growing from Mexico, under the Aztec Empire, to Peru, under the Inca Empire. Avocado was among the plant species, such as maize, common bean, tomato, potato, pumpkin, that were unknown to the Spanish conquistadores. Some of these plant species, such as maize and cacao, were not only used in the food of autochthonous peoples but they were also part of their rituals. Through thousands of years of cultivation, the indigenous farmers have been able to select the best seeds of the avocado tree and to obtain a product that has been very successfully traded.

From the Aztec word *ahuácatl* are derived the Spanish word *aguacate* and the English one avocado. In Mexico's vernacular language *náhuatl*, the word *ahuácatl* means testicle, because of the shape of avocado fruits that look like man's genitals. In fact, avocado was considered by the Aztecs as a source of virility. The common name of avocado in Latin America is *palta* (*Persea americana*), belonging to the Lauraceae family, like *Laurus nobilis* – a high tree dedicated to Apollo in the Antiquity and of which the aromatic leaves are used in the Mediterranean cuisine.

Brief historical data

The oldest publication that mentions avocado is most probably Martín Fernández de Enciso's (1470-1528) book *Suma de Geografia que Trata De Todas Las Partidas e Provincias Del Mundo* (Geographical Compendium Of All Parts and Provinces of the World), published in 1519. He has described the avocado in the following terms: "what is inside is like butter, it has a delicious savour and it leaves a taste that is as neutral and good, as wonderful." The Spanish geographer tasted avocadoes in Yaharo, in Santa Marta region of today's Colombia, where he was sent as a civil servant by the Spanish Crown. During the same year, Hernán Cortés (1485-1547) started the conquest of the Aztec Empire, also on behalf of the Spanish Crown. He had the opportunity to notice that in the market of Tlatelolco indigenous people were trading many items, including the avocado. Another Spanish conquistador, Gonzalo Fernández de Oviedo (1478-1557), acting as the first oficial chronicler named by the Crown, has also described the fruit during his stay in the north of today's Colombia. His natural description has been published in 1526 in his *Sumario de la Historia Natural*

de Las Indias (A Summary Of Indies' Natural History). This report was written during one of his frequent journeys to the Iberian Peninsula, at the request of King Charles the First of Spain – the Habshurg Charles the Fifth. This historiographic work is highly acknowledged today because it is a comprehensive report of what, during that period, drew the attention of the Europeans when they encountered an unknown world (Universidad Latina de América, UNLA, 2011).

Another explorer of the region, Pedro Cieza de Léon (1518-1540), who travelled through the tropical areas of the continent from 1532 to 1550, observed that his fellow countrymen settling in these areas were eating avocadoes, in the same way as indigenous peoples did. Pedro Cieza is considered by historians as the first explorer who used the word *aguacate*, in 1550, and this became the universal Spanish (*castellano*) denomination of the fruit. P. Cieza did not know the *Nueva España* (New Spain), but he stated that the avocado tree was cultivated in the whole region that includes today's Panama, Ecuador, Colombia and Peru. In addition, one of the first Chroniclers of Mexico, Francisco Cervantes de Salazar (1513-1575), who was several times the Rector of the Royal and Pontifical University of Mexico (*Real y Pontificia Universidad de México*), mentions in his book tilted *Crónica de la Nueva España* (Chronicle Of New Spain) and published in 1554, that avocadoes were traded and, more precisely, were bartered in the market of Tenochtitlan – the heart of the future Mexico City (UNLA, 2011).

José de Acosta (1539-1600), a Jesuit and renowned naturalist and anthropologist, published in 1590 the *Historia Natural y Moral de Las Indias* (Natural And Moral History Of The Indies), where he described the rituals, beliefs and ways of life of the autochthonous peoples of Mexico and Peru; he gave the most comprehensive description of the fauna and flora of America that was known at that period. He also mentioned the avocado tree, being aware that the Spanish Crown forbade any communication on the natural wealth of the New World so as to keep them secret from any other rival country. In this regard, Francisco Hernández de Toledo (1514-1578), a physician and historian at the service of King Philip II, published a brief *Historia de las Plantas de Nueva España* (History Of The Plants Of New Spain). In this book, one can find the most detailed description of the avocado, which was designated by its *náhuatl* name (*ahoacaquahuitl*). Thanks to a Codex of the end of the 16th century, called the *Mendocino* – because it has been prepared upon the request of the First Viceroy of New Spain, Antonio de Mendoza, from 1535 to 1540 – we learn that the word *ahuacatlán* was given by Aztecs to a human settlement where the avocado fruit was abundant. There are presently several populations bearing this name in Mexico and in Guatemala as well – this is an additional evidence of the Central American origin of this fruit tree. In the Mexican State of Michoacán (centrenorth of the country), the avocado is called *Cupanda* in the vernacular language of the area – the *purhépecha* – and this name is still used as *Copándaro* – a place where grow avocadoes – or *Cupátaro* – a place where avocadoes have been grown. Michoacán is nowadays the biggest-producing and exporting region of avocadoes (UNLA 2011).

In 1605, in Peru, another famous writer, the Inca Garcilaso de la Vega (1539-1616), stated in his *Comentarios regios de los ínc*as that the avocado fruit was given the name of *palta* by the Incas who introduced it from the Cuzco Valley or the so-called

province. *Palta* is the current name of avocado in South America. It was a Peruvian Jesuit, Bernabé Cobo (1580-1657) who distinguished three original avocado varieties in his *History of the New World* – finished in 1653 but published only in 1890. The avocado varieties were the Mexican, the Guatemaltecan and the Antillean ones – the last one being probably an ecotype or a mutant of the Guatemaltecan variety adapted to its new environment, the Caribbean Islands. W. Hughes, a physician of King Charles II of England, also suggested that the third variety of avocado might be a mutant of the Guatemaltecan one, and he mentioned in his book *El Médico Americano* (The American Physician), published in 1672, that the "Spanish pear" was grown by Spanish settlers in Jamaica. He therefore suggested that this variety was not cultivated in the Antilles before the arrival of the Spaniards to the New World (UNLA, 2011).

In 1696, Sir Hans Sloane (1660-1753), the famous Irish physician, botanist and collectioner – who founded the British Museum – published a catalogue of Jamaica's plants, just after this strategic island was taken from the Spaniards; in this catalogue, for the first time, the word avocado was used and later on it was the name adopted for the fruit (and tree) in the English language. It is interesting to discover how the *náhuatl* name "*ahuácatl*" has evolved into *avocado*, through *abdecata*, *avigato*, *avocato*, etc., that were used in different periods. In a document published in 1751, George Washington, who at that time was a rich farmer – before becoming the first president of the United States –, discovered the avocado tree in Barbados, in the Lesser Antilles. There, the *agovago* pear – as G. Washington heard the locals name the tree – was "very popular and abundant" (UNLA, 2011).

Francisco Javier Clavijero (1731-1787), a Jesuit priest born in the harbour city of Veracruz (Gulf of Mexico) and the son of a Spanish father and a Creole mother, was the last of the prominent historians who dealt with the origins and development of the avocado tree during the Colony period. When the Jesuits were expelled from New Spain in 1768, Clavijero migrated to Italy, where he wrote the *Ancient History of Mexico*. One can draw the conclusion that the curiosity induced by the avocado during the whole history of Mexico, is well documented; during the 300 years of the Colony the avocado remained an "exotic" product for the rest of the world, although the Spaniards were in charge of disseminating the avocado through all the Spanish Crown's possessions where the climatic conditions would permit the cultivation of the tree, i.e. Venezuela, the Antilles, Chile, Canary Islands. During the 18th century, France introduced the avocado tree into its own colonial territories, i.e. Madagascar and Martinique (UNLA, 2011).

Introduction of the avocado tree in the United States

In 1833, the avocado was brought into Florida by Henry Perrine, a physician and horticulturist, who was the Unites States' consul in the Mexican city of Campeche (Yucatan Peninsula). In 1848, the first plantation of avocadoes was established in California, with plants from the region of Puebla. The Agricultural Society of the State of California recorded that in 1856 Thomas W. White was cultivating avocadoes in the region of Los Angeles, while the first successful graft of trees of Mexican origin was performed by the judge R.B. Ord of Santa Barbara. On the campus of the University

of California, Berkeley, one can find the oldest and still alive avocado tree, probably planted there in 1879. In the early 1890s, Mexican migrants brought with them avocado plants which they grew in the region of Los Angeles. Juan Murrieta, a resident of Los Angeles, imported a large quantity of avocado specimens from the region of Puebla. He widely distributed the plants among his friends, and it was from this variety of avocado – a fruit with a thin peel – that a widely-traded product has emerged (UNLA, 2011).

In 1912, Frederick O Popenoe, a visionary producer and owner of a company called West Indian Gardens, Altadena, California, sent to Mexico one of his employees, Carl Schmidt, in order to collect the highest-quality avocadoes. C. Schmidt found in an orchard near Puebla avocadoes that tasted very well and of which he brought several samples that were grown successfully. However, two years later, the region was hit by a large-scale frost and only one avocado tree did survive; for this reason and since 1913, the frost-resistant variety was named Fuerte in Spanish. In 1915, the California Avocado Society was created, with a view to growing the tree on commercial scale. Since then, scientific research-and-development on avocado improvement through genetic selection has started. Based on the Fuerte variety in California, it was possible to achieve a commercial production, despite the drawbacks of the variety: a relatively thin peel and a short ripening period. The local consumption of the fruit was nevertheless increasing and the demand led producers, with the assistance of the US Department of Agriculture (USDA), to develop new varieties the fruits of which would meet a large-scale trade. That was the birth of the avocado industry, fostered by the development of the new *Hass* variety (UNLA, 2011).

Development of the Hass avocado variety

This is the most popular avocado variety, both in California and in the rest of the world. The weight of the fruit of this variety varies significantly; its skin is rough and dark green when it is ripe. Its main advantage from the commercial viewpoint is that it is produced all the year round in Mexico, at altitudes ranging from 1,000 m to 2,500 m. In addition, it is possible to let the fruits ripen on the tree and therefore to schedule their harvest and commercialization at the right time for the growers. The story of this avocado variety started when it was found by chance next to plants sown by A.R. Rideout in his orchard, located in a suburb of Los Angeles. A.R. Rideout was an innovative pioneer in avocado selection, as he was trying to discover new varieties through sowing a large number of seeds of plants he came across. He was doing so not only in his own orchards, but also in those of his neighbours as well as in public gardens. By the mid-1920s, Rudolph Hass, who was working in the mail service, bought from A.R. Rideout a few plantlets which he grew in his own garden. The end result was the discovery of a new variety, almost perfect that fostered the avocado international trade. Rudolph Hass patented the variety in 1935, under his name, but this did not bring him any advantage. It is sometimes the fate of a discovery which, although bearing the name of its discoverer, remains in the public domain. R. Hass died in 1952, a few months after his patent on the eponymous avocado variety (17 years) had expired (UNLA, 2011).

Avocado industry in Mexico

Michoacán, a State of centrenorth of Mexico, has the optimal conditions for the large-scale cultivation of avocado. One of these conditions is the wide diversity of microclimates present throughout the State: from the tropical climate in the lowlands next to the Pacific Ocean coast, to the temperate and cool climates that prevail in the region called the Neovolcanic Axis. Here, altitudes reach 2,500 m above sea level and here also is located the highest summit of the State (3,845 m). The town of Uruapan lies between these two extreme regions and it receives abundant rainfall between June and October; in addition, it has important groundwater resources and it is protected from the frost by the surrounding hills. Uruapan is the centre of the so-called Avocado Fringe (*Franja Aguatera*). The acreage of growing avocadoes has been extended beyond this area, in the State of Michoacán and in other neighbouring States. Because of the world demand of the fruit, forest areas are also being converted into avocado orchards, thus raising major environmental concerns (UNLA, 2011).

Uruapan is called the "World Capital of the Avocado": it is around this town that the tree can be easily grown and bears fruit all the yearlong. The name of the town is probably derived from the vernacular (*purépecha*) word *Urapani*, meaning "the place where all the plants blossom and bear fruit at the same time." The following dates could summarize the development of Mexican avocado industry.

- 1935: Rudolf Hass patended the *Hass* avocado variety which he selected in his 1.5-acre orchard in La Habra Heights, California.
- 1957: Mladosich Lelov, a professor of agronomy at Uruapan's San Nicolás de Hidalgo Michoacan University (UMSNH, Spanish acronym) Faculty of Agrobiology, has promoted the introduction of improved avocado varieties.
- 1959: Gil Henry, an American horticulturist, invited by Mexico's agriculture ministry, traveled across the country with a view to mapping the regions most suitable to growing avocadoes. He in fact recommended that the region of Uruapan was the most suitable place. Since 1960, he has been exporting to Mexico the *Hass* avocadoes, as well as other varieties selected in his orchards located in Escondido, California. He promoted a programme aimed at selecting improved avocado varieties.
- 1965: The import of cuttings from Californian orchards came to an end, because a sufficient number of "father trees" in the Mexican plantations could supply the newly-created orchards.
- 1970: After the announcement by the Mexican Institute for Foreign Trade of the first commercial export of one ton of avocadoes to France, the United States' Animal and Plant Health Inspection Services (APHIS) rejected Mexico's request to export avocadoes because of phytosanitary reasons. The request was again rejected in 1975 by APHIS for the same reasons – the American service considered that Mexican orchards were plagued with several pests.
- 1978: Several Mexican companies as well as the Uruapan (Michoacán) Cooperative Society of Avocado Producers dispatched samples of avocado, via airmail, to Europe, Canada and Japan, in order to check their safety.

- In the late 1980s, a field study was carried out in the State of Michoacán in order to identify avocado orchards that were free of drilling worms in the stone of the fruit and in the tree branches. Another request to export avocadoes to the United States has been rejected by the USDA, because the avocado orchards in Michoacán could host the Mexican fruit fly. Researchers of the Plant Sanitary General Directorate, nevertheless, were able to demonstrate that this was not the case; but the United States maintained their embargo.
- 1994: The North America Free Trade Agreement (NAFTA), including Mexico, has been signed and the APHIS authorized, for the first time, the export of Mexican avocadoes to Alaska. Meanwhile, Mexico succeeded to export 30,000 tons of avocadoes to Japan and 32,000 tons to France in 1995-1996.
- On the 4th of July 1997, the Association of Producers and Packaging Companies Exporting Michoacán Avocadoes (APEAM) was created and, on the 1st of November 1997, Mexico could export the first shipment of avocadoes to the United States. Until 2001, the fruit had to be exported from November to February (four months) and only to the 19 Northeastern States of the country.
- On 16 June 2003, an in-depth field study was carried by Martin Aluja, considered one of the world's three best entomologists at that time; it was demonstrated that the *Hass* avocado variety was not the host of the Mexican fruit fly. The conclusions of the study were published in the *Journal of Economic Entomology* and they put an end to the controversy.
- At the end of January 2007, the whole of the United States market was opened to the exports of Mexican avocadoes, including California – the State with the greatest potential for the fruit. And at the beginning of February 2007, all the relevant Mexican and US authorities greeted the first shipment of avocadoes to California after 93 years of embargo.
- In 2008-2009, 300,000 tons of Mexican avocadoes (fresh fruit) were exported to the United States, more than 24,000 tons to Japan, 23,000 tons to several Centro-American countries, 18,000 tons to Canada and 10,000 tons to Europe. Forty percent of these volumes came from the State of Michoacán – considered as the world's largest avocado-producing region (UNLA, 2011).

Thus, the Mexican avocado agroindustry has grown firstly in the State of Michoacán, and thereafter it was extended to a few neighbouring States such as Jalisco and Sinaloa. For instance, in Uruapan (one of the five municipal districts of the "Avocado Fringe"), the local government in charge of phytosanitary control recorded in 2009-2010 a harvest of 76,000 tons of avocadoes of which more than 63,000 tons have been exported. The orchards have been certified by the USDA APHIS as free of disease or pests across the whole State of Michoacán; every year, two inspections are carried out in the orchards in order to reconfirm their exporting license; those which cannot comply with the standards of good practices required by the USDA and the local control authorities are blacklisted. In Michoacán, avocado is a pillar of the economy and it was nicknamed the "Green Gold" of Mexico (UNLA, 2011). During the second decade of the 21st century, Mexican avocado exports have steadily risen to respond to

a worldwide increasing demand of the fruit: from more than 270,000 tons in 2009-2010 to 1.2 million tons in 2018. In the two other exporting countries, Chile and California, the figures were: *ca*. 135,000 tons and *ca*. 123,000 tons, respectively, in 2009-2010; and *ca*. 147,000 tons for Chile in 2018. Also Peru became a big exporter with *ca*. 360,000 tons in 2018. See also p. 285.

Kenya: a new actor of the international avocado trade

The avocado tree has been introduced into Kenya by the British settlers. Until the 1970s, it was just a tree grown in the *shambas* – the small plots of individual farmers – and its fruits were consumed within the household. At that time, coffee was grown for export and it became Kenya's emblematic tree, particularly in the fertile region lying between the Aberdare mountain ridge and Mt Kenya, a non-eruptive volcano. On the red and viscous soils of this region coffee was thriving, particularly in the county of Muranga which can be reached after two-hours drive from Nairobi – the country's capital. When the coffee prices began to fall down, locally-elected politicians involved in the international (coffee) trade began to lay emphasis on avocado. Farmers have progressively replaced coffee trees with the avocado *fuerte* variety, and thereafter with the Hass variety that nowadays is predominant on the international market (Douet, 2019).

Kenya's high plateaux have good climatic conditions for avocado cultivation: a rather high altitude and a favourable temperature, two rainy seasons a year and therefore a limited need for irrigation, as well as a low fertilizer input. The company Fair Trade Limited collects the fruits at the farmers' plot level and the growers are paid in cash (per kilogram) via M. Pesa – the Kenyan mobile payment system. The overall business is more profitable than coffee exports – because coffee needs more care and the harvest of the berries is time-consuming and tedious. According to a local farmer, "the money earned is not that big, in the case of coffee, 50 shillings or €0.43 per kilo, but once the farmer's expenses are deducted, the overall profit is 10 shillings per kilo; in the case of avocado, the profit reaches 45 shillings for the farmer, on the basis of a selling price of 50 shillings per kilo. "On the thousands of small plots – they often have an acreage of less than 10 hectares – the farmers are still growing plantain and banana trees, papaya, coffee, maize and vegetables. But the smallholders are increasingly interested in cultivating avocadoes that bring higher profits (Douet, 2019).

While the smallholders remain the main producers of avocadoes, large industrial farms are rare, but it is true that Kenya is quickly adopting this crop: in ten years, exports of avocadoes have jumped from 15,700 tons to 75,000 tons in 2018. Kenyan authorities who are very supportive of this export crop – that brings in hard currency – claim that they have been exporting in 2019 more avocadoes than South Africa, which was hit by recurrent droughts. According to Bernard Kimutai of Fair Trade Limited there is much more available land for avocado cultivation and he expects a big boom in exports in five years. There is an emphasis on growing avocado in organic conditions and in 2019 2,500 farmers were already involved in this form of cultivation. Kenya's avocado production easily finds outlets because of the increase in this fruit consumption in Europe and the United States – the biggest avocado markets. In fact, the imports of

avocadoes have an annual growth rate of 15% and 12% in these regions, respectively. The fruit with its creamy and yellow-green flesh is rich in fibers and desaturated fatty acids – no cholesterol (Douet, 2019).

World exports of avocadoes have more than doubled in ten years and reached 2.2 million tons. "This boom started in 2011-2012 in Europe – the main market for Kenya's exports – and at the beginning of the 2010 decade in the United States," highlighted Eric Imbert, specialist of avocado economy at the French International Cooperation Centre in Agricultural Research for Development (CIRAD, French acronym, Montpellier, southeast of France). Another market for avocado is now opening up in China and its 1.4 billion people and potential consumers. In April 2019, Kenya's president, Uhuru Kenyatta, signed a commercial agreement with the Chinese president Xi Jinping which would enable Kenya to export 40% of its avocado production in the medium term. The Kenyan exporters are very happy regarding this prospect, even though China buys avocadoes cut into pieces and frozen, while Europe imports whole fresh fruits. "This is a very good opportunity, despite the fact that fruit processing is more complex," stated Tiku Shah, director-general of the exporter company Sunripe, which is well equiped and works with the French company Picard – specialized in frozen foods. A similar approach was that of Keitt, another export company, which is "building a highly advanced factory that will produce, as of 2021, frozen avocadoes and avocado oil," explained its director, Asif Amin (Douet, 2019).

Eric Imbert of the CIRAD was less enthusiastic. He explained that Kenya is not the ideal country that could respond to this very specific demand, that is within the reach of a few manufacturers. "This technique of ultraquick freezing, called IQF, needs colossal investments; it is already available in big industrial groups such as Camposol in Peru." And this situation is far from Kenya's approach to the development of avocado industry. Kenya remains a modest actor at the international trade level: it is nowadays at the sixth rank of avocado exporters, far behind Mexico, Peru or Chile. The latter are exporting 1.2 million, 360,000 and 147,000 tons per year, respectively, and they are fostering more industrial and standardized fruit processing. B. Kimutai of Fair Trade Limited explained in this context: "In these Latin American countries avocado cultivation is practised on a large scale, while we are working on small areas. It is therefore a challenge for us to produce a fruit with standardized features, that could compete with their rivals exported from Latin America." In fact, Kenyan avocadoes are being sold cheaper than their rivals on the international markets. B. Kimutai, a young agronomist, added: "*Ca*. 30% of Kenyan avocadoes are not exported because of defects concerning their size and shape, or because of bad handling." E. Imbert, on his side, stated: "Demand is presently very strong, there are considerable transformations in South America, the markets are becoming more complex and competition is increasing." And all these foreseeable events might hamper the small Kenyan growers to play a key role in this commodity trade (Douet, 2019).

Avocado nutraceutical properties

A Hass-variety avocado, having the size of a pear, contains in its flesh, once the stone has been taken away, the main following components:

- Water	72 g	- Calcium	13 mg
- Proteins	2 g	- Phosphorus	54 mg
- Carbohydrates	9 g	- Sodium	8 mg
- Lipids	15 g	- Magnesium	29 mg
Saturated	2 g	- Potassium	507 mg
Polydesaturated	2 g	- Iron	0.6 mg
Monodesaturated	10 g	- Zinc	0.7 mg
- Cholesterol	0 g	- Copper	0.2 mg
- Beta-sitosterol	76 mg	- Manganese	0.1 mg
- Fibers	68 g	- Selenium	0.4 mg.

Avocado is rich in vitamins: A (147 international units), C (8.8 mg), E (2 international units) and B1 (0.1 mg). The energy intake when eating an avocado of this size is equivalent to 167 kcal (UNLA, 2011). The poly- and mono-desaturated fatty acids, including oleic acid, contribute to lower the levels of cholesterol, particularly those of low-density lipoproteins (LDL) in the bloodstream. The beta-sitosteral plays a similar role. All the vitamins contained in the avocado fruit play a key role in the immune system, skin health, brain and nerve development, as well as in cell metabolism. There are also antioxidant molecules which protect the cells against free radicals. In addition to its nutraceutical properties, the avocado fruit can be combined in a wide variety of meals: salads, sauces, creams, or the worldwide-known Mexican *guacamole*, obtained after grinding the pulp of the fruit and adding to it onion, coriander and chilli.

Persimmons (kaki)

The story of the kaki starts with its identification in the 17th century by an Italian Jesuit, Matteo Ricci; that was the Chinese kaki. It was thereafter Joseph Banks, a botanist and a companion of Captain Cook, who brought the first plants to Europe. There are probably more than 2,000 varieties of kaki, a fruit tree that was born in China, more than 2,000 years ago, and thereafter exported to Korea and Japan, where the plant had been named *kaki no ki*, or the kaki tree. It has been cultivated since the 19th century in the region of Nice, France, under the name of *muscat kaki of Provence* or Japanese apricot. It was the French navy engineer, Edouard Dupond, who set up, in the 1870s, a collection of 27 varieties of *Diospiros kaki* in that region (Géné, 2012).

In Spain and until the year 2000, the kaki was cultivated in very small plots. The fruit is very soft – it could be eaten with a tea-spoon – and can rot in a short time; it is therefore only consumed locally. But nowadays, there are *ca*. 15,000 hectares of plantations of kaki, according to the data of the Agricultural Service of the province of Valencia. In the latter, orchards of oranges and tangerines coexist with plantations of a red variety of kaki. In less than a decade in the heart of the province, the community of La Ribera Alta, the horticultural landscape has changed: citrus orchards have been replaced by large plantations of deciduous kakis; the red fruit has triggered a real "fever" among the farmers who were trying to increase and diversify their income derived from the exports of Valencia oranges. This new trend was named the "kaki

revolution" (Ferrandis, 2015). Despite the amazing encroachment of the kaki, the acreage of the orange orchards remained dominant, more than 98,000 hectares. But this horticultural transformation was due to the commercial potential of this gloss-red kaki variety as well as to the development of a process aimed at eliminating the astringency of the fruit before it completes its ripening. The end result is a fruit which tastes like a sweet apple, without pips, and is very attractive. "This was the unique innovation that has an impact on commercialization during the last ten years (2000-2015), since the introduction of the kiwi," stated proudly Cirilo Arandis, who is considered as the "father" of this transformation. In 1997, C. Arandis, chairman of the Federation of Agrifood Cooperatives of the Valencia Autonomous Region (*Comunitat Valenciana*), has promoted the creation of a denomination of origin (DO) for the kaki Ribera del Xúquer, under the brand Persimón. In 2015, this DO was claimed by 7,000 associated farmers (Ferrandis, 2015).

In 2015, the harvest of kaki amounted to 220,000 tons of fruit, and more than 15,000 persons were employed in that horticultural sector. With an average growth rate of 20% during the decade 2000-2015 the Valencia Autonomous Region produced 90% of the kaki in Spain, according to the data supplied by the agriculture ministry. The forecast was to double fruit production in 2020. Due to this "kaki bubble" and during the agricultural campaign 2013-2014, 1.2 millions of certified kaki plants were sold in the Valencia Region, and this figure was twice that of almond and citrus cuttings. "Nurseries who used to sell 10,000 to 12,000 plants, now sell more than 100,000 within and outside the Valencia Region. The reasons for such a situation are the profitable prize of the fruit and growth prospects. The Persimón kaki was sold at a prize of €0.4 to €0.5 a kilo in 2015, while the prize of the majority of orange and tangerine varieties was between €0.15 and €0.30. In some villages, the cultivation and commercialization of kaki brought in a new prosperity: kaki cultivation has been perceived as a new El Dorado and more citrus-plantation owners wanted to increase their income by converting their orchards into kaki ones (Ferrandis, 2015).

The introduction and expansion of kaki horticulture followed, during the decade 2000-2015, that of *kiwi* in Spain. In the case of France, the *kiwi* was not cultivated before the 1960s, when an agronomist, Henri Pédelucq (1926-1995), promoted the plantation of this fruit tree; the latter was called Chinese gooseberry before its cultivation in New Zealand where it was named *kiwi*, the country's emblematic bird. The French agronomist travelled several times to New Zealand and brought with him several stocks of *Actinidia deliciosa*, a "large oval" variety from the locality of Hayward, which he planted in the southwest of France. After successful trials, the orchards of the Adour region (southwest of France), that were awarded a protected geographic indication, supply *ca*. 20,000 tons of fruit per year, i.e. one-fourth of national production (Géné, 2012).

Dates

Five thousands years ago, the date palm (*Phoenix dactylifera,* Arecaceae) has played a crucial role in the survival and expansion of the Middle Eastern civilizations: date-palm wood has been identified by archaeologists in the human settlements of these regions, and the wells used to preserve dates in many Mesopotamian

archaeological sites. The date palm found its way in christianity, as well as in the Bible and the Koran. The Romans considered the palm leaf as the trophy to be awarded to military or sports winners. Christians also associated the palm with the celebration of Palm Sunday, while for the Jews it was a sign of peace and bounty. With respect to Islam, it is narrated that the Prophet Mohammed had built his own house as well as the first mosque using palms and the stem wood of the tree. From the Arabian-Persian Gulf, the tree species spread across the Middle East and North Africa between latitude 15° and 30° north. The date palm has many cultivars adapted to the various environments where it grows or is being cultivated.

The genome of *P. dactylifera* has been sequenced by Saudi scientists of the King Abdul Aziz City in Ryad, in collaboration with the Beijing Genomics Institute – BGI – of Shenzhen. This genetic map aims to increase the productivity of the palm and also to prevent or treat the diseases affecting *ca*. 100 million date palms growing in arid or semi-arid regions; and to improve water supply to the groves through conventional or sophisticated irrigation systems or in oases. The best date variety is called *mejhoul* and it is harvested in the Middle East and Morocco; in this country the mejhoul-date palms have been almost destroyed by a parasitic soil fungus, *Fusarium oxysporum* subsp. *albedinis*; the fungus invades the roots of the palm and multiplies in the vascular system of the plant, finally choking and killing the palm, of which only remains the trunk, while the leaves die after bearing white bands on their margins – this explains the name of the subspecies *albedinis*. The Moroccan Agricultural Research Institute has a very large collection of date-palm varieties – unique in the world – and its scientists have been selecting, over many years, *Fusarium*-resistant or tolerant varieties. These varieties have not always the same quality as the *mejhoul* dates, but at least they can reestablish palm-tree orchards in their native regions and even serve to set up plantations of the tree.

In the 1980s, Israeli planters have been able to collect a few stocks of the *mejhoul* variety and they strived to cultivate it in the Jordan Valley, Beit Shean Valley or in the Arava Desert. This endeavour has been very successful and the Israeli cooperative Hadiklaim Ltd. has exported its production to California, where the weather is very favourable to growing date palms. Nowadays, the majority of *mejhoul* dates come from plantations in Israel and the United States, and they are commercialized under Hadiklaim's brands: King Salomon and Jordan River (Géné, 2014). The *mejhoul* date is generally bigger than other varieties, with a wrinkled and less sticky sheath. It is onctuous with a "fatty" sensation. It is a foodstuff of the nomadic people roaming the deserts of the Near and Middle East and also of the people living in the oases. It is obviously very rich in sugar, it contains minerals and micronutrients. The competitor of the *mejhoul* variety is the Algerian *deglet nour* (fingers of light). The *deglet nour* is the typical Saharan date, cultivated in the Zibans region, near Biskra in Algeria, or in the Southern Tunisian oases of Jerid and Nefzaoua. While the Israeli cooperative Hadiklaim exports *ca*. 10,000 tons of *mejhoul* per year in some 30 countries (by the mid-2000s), the *deglet nour* is more common in France. It is commercialized under a sheath of cellophane, in boxes, or on the yellow twigs that used to bear the female flowers – the date palm being a dioic plant. The *deglet nour* dates are generally dried, and they contain 15% to 20% water instead of 65% to 70% in the fresh dates, which are

difficult to preserve. The *deglet nour* date is an oblong, pulpy and crunchy fruit, very sweet and energy-provider; it is four- to six-cm long and contains a stone (seed) with a longitudinal furrow. Algeria is the biggest producer of *deglet nour* dates in volume, but Tunisia is the first in terms of value. The exports supply mainly the French market – France being the biggest consumer in Europe (Géné, 2014).

Pistachios

Competition between the leading producers

Since the 2000s, the United States and Iran have been competing for the first rank of the world's biggest producers and exporters of the dried fruit pistachio. The latter has a very long history as a food ingredient among nuts and its demand has been growing tremendously. Before the Islamic Revolution of 1979, Iran boasted itself as the world's biggest producer and exporter of pistachios, as well as the first supplier of the United States, according to the comments made by an economist of the United States Department of Agriculture (USDA). But when the political relations between the two nations worsened and economic sanctions were imposed by the United States on Iran, the exports of pistachios to the United States fell down. In the Near East, the production of pistachios reached 210,000 tons in 2016, and the estimates by the USDA foresaw a production of 250,000 tons by the end of 2017. In the United States, by contrast, due to recurrent droughts, the harvest of pistachios fell down to 122,247 tons (-47.5%) – the lowest figure in almost a decade 2010-2017. Turkey which for many years has been keeping its third rank among the world's biggest producers of pistachios, harvested more fruit than the United States, i.e. 130,000 tons. The harsh competition between the United States and Iran, which both control more than 60% of the global production of pistachios, was strengthened after the United States decided in 2016 to impose a series of economic sanctions on Iran, which have forbidden any trade with the latter country. The wide range of restrictions between 2006 and 2010 resulted in the loss of the Iranian trade and in the rise of the American producers of pistachios, especially in California. To fill in the gap left by the loss of the Iranian supply, the Californian producers did increase their production: from *ca*. 7,700 tons in 1979 to 29,000 tons by the mid-1980s, according to the data provided by the United Nations Food and Agriculture Organization (FAO). In 2014, the value of the American pistachio production amounted to US$1,300 millions (Granados, 2017).

When the Californian producers disrupted the market, Iran tried to find a European outlet for its production during the 1990s and in fact it exported two-thirds of its production to Europe. But in 1997, the European regulatory agencies detected high concentrations of aflatoxin – a mycotoxin produced by *Aspergillus flavus* – in the pistachios exported to Europe and thereafter took measures leading to stricter phytosanitary regulations by the European Union. Once again, the United States seized the opportunity to replace the Iranian exports to Europe. Consequently, Iran tried to commercialize its pistachios in the Middle East and Asia, which had less demanding regulations. Therefore, in 2009 and for the first time in history, the United States were able to export much more pistachios than Iran. And this was achieved with half of the cultivated acreage, underlined Richard Matoian, executive director of the American Pistachios Growers, a Californian association that included 700 pistachio farmers (Granados, 2017).

The weather has played a key role in the competition between Iran and the United States. In 2015, an intense drought hit California and therefore affected the production and sales of American pistachio growers. Consequently, Iran took the lead and in 2016 strengthened its position, exporting 190,000 tons of the produce, while the United States' exports reached a paltry 80,000 tons. With a view to protecting its own industry, the United States have maintained for more than two decades an antidumping tax of almost 250% on imports of pistachios from Iran – which had a lower market price. In 2017, the United States' production of pistachios amounted to between 250,000 and 270,000 tons of the fruit, and China and the European Union, that consume five out of ten pistachios that are sold across the world, were coveted by the American producers. But Iran has tried to retaliate: in 2017, the agriculture ministry stated that the national production of pistachios would reach 300,000 tons; it is worth mentioning that pistachios are Iran's second-biggest export, behind petroleum and oil products (Granados, 2017).

The trendy consumption of pistachios has not spared some countries in Europe such as Spain, where there is more than 20,000 hectares cultivated with the fruit tree. In 2016, the harvest amounted to 1,500 tons of dried fruit, a paltry quantity in comparison with the production and exports of the world's leading countries. However, the prospect was to reach a production of 15,000 tons by 2022, according to the Agro-Environmental Research Centre (*Centro de Investigación Agroambiental*) El Chaparrillo, ubicated in Spain's region of Castilla-La Mancha (centre of the country), that produces more than 80% of the national output. The producers aimed to export a large part of their dried fruit, because the domestic market is in the hands of United States' companies. Germany, the main consumer of pistachios in Europe, was targeted. Spain's policy is to offer a high-quality product, and the director of the above-mentioned research centre underlined that "50% of the farms grew organic pistachios and that Spain's future market was there" (Granados, 2017).

Resilience to global warming

Global warming is threatening pistachio orchards in the United States and probably elsewhere. The clear warning came during the winter of 2014-2015, the warmest on record in the southern San Joaquin Valley, in California. Historically, orchards there, about 125 miles north of Los Angeles, enjoy cool, rainy winters and dense fog. But Statewide, average temperatures have increased more than 2° Fahrenheit in the past century. In particular, the Valley's wintertime lows have risen four times faster than its summertime highs. Making matters worse, the famous Tula fogs that cool the valley have dissipated by 46%. During the winter of 2014-2015, the southern valley experienced only about half the chill hours that the pistachios needed and not a single day of fog. The industry had therefore its lowest yield in more than 20 years (Cone, 2019). Cherries had a similar dismal year in 2014. Production dipped 63% to the smallest crop since 1993. Then during the 2019 winter, a cold snap killed walnut trees up and down the valley. "Walnut growers had never seen anything like it," stated Pat J. Brown, an associate professor at the University of California, Davis, who breeds walnuts and pistachios. "In this case, it did not just destroy a year's crop, it killed mature trees." Rob Yraceburn, the president of Wonderful Orchards, the largest

producer of pistachios in the United States, said: "We have always had uncertainty. But now there is even more uncertainty" (Cone, 2019). The first warnings came in 2019, when a team of scientists reported that chilling hours in some parts of California had already dropped by 30% between 1950 and 2000, and that the decrease would reach 80% by the end of the 21st century. "For some crops, production might no longer be possible. Areas where safe winter chill exists for growing walnuts, pistachios, peaches, apricots, plums and cherries are likely to almost disappear by the end of the 21st century," the scientists wrote (Cone, 2019).

After the dismal 2015 harvest, California growers decided that they needed pistachios trees designed for warmer winters. But it takes some 20 years to breed, test, grow and harvest a new variety of nut tree, so experiments undertaken now will not have quick results. Wonderful Orchards took nevertheless the stopgap step of planting some experimental male trees that shed pollen at various times, hoping their cycles would match more female trees. "It is a challenge for all permanent crops, because it takes so long. Others like carrots or lettuce are 90-day or 120-day crops, so you can try something and know right away if it works. For trees, you do not even obtain any results until four to eight years down the road. You do not know if your experiment works for a long time," stated R. Yraceburn (Cone, 2019). For some crops, scientists are going back to their origins, searching, for instance, for old varieties of nuts grown in the Middle East. "All of the things we grow in California have a wild relative or a variety on the market elsewhere that correctly grows with warmer winters," stated Katherine Jarvis-Shean, a University of California researcher who advises orchardists on how to cope with climate change. The USDA has repositories that store genetic material from every type of tree on earth. Dan Parfitt, a now-retired University of California, Davis, plant geneticist, started breeding pistachios using tissue from those repositories more than 30 years ago in an effort to help growers economize their harvest. As the climate changed, D. Parfitt had the idea to plant a few hundred trees in the Californian desert. "The Coachella Valley is the closest to the warmer winters and drier conditions that we will see in the San Joaquin Valley in 20 or 30 years," he stated. These new breeds have an array of old names such as Gumdrop, Lost Hills and Famosa. Many growers have already planted some in their orchards. D. Parfitt was confident that the pistachios of the future will be dominated by trees bred for climate change (Cone, 2019).

Almonds

California indeed has become the world's cradle of the cultivation and production of almonds. In a decade, in the Central Valley of this State, located a few miles from the Silicon Valley, the acreage of almond orchards has doubled and they produce about 80% of the fruit sales. This is far ahead of Europe and Australia which contribute each 8% of the world's production. In 2016, the world's production amounted to 1,174,000 tons, with the following proportions for the main producing countries: 79% for the United States, 8% for the European Union, 7% for Australia, 4% for China, 1% for Turkey and 1% for the rest of the world. The production of shell-free almonds grew up to 862,000 tons in 2015 in the United States – doubling in ten years –, while the French production amounted to 789 tons (Girard, 2017a).

The green (almond) gold rush continues as Californian farmers had increased the cultivated acreage in 2016 and during the following years, thus reducing the area planted with cotton and melon. The acreage amounted to 3,640 km^2 – while the whole area of the Ile-de-France region that includes Paris is estimated at 12,012 km^2. One of the reasons of the green gold rush has been the increase in the price of the fruit, thus enhancing the productivity of the Californian orchards. In billions of US dollars, in 2014, Californian almond exports were estimated at 4.5, compared with 2.4 for milk and dairy products, 1.5 for walnuts, 1.4 for wine and 1.12 for pistachios. However, in 2015, after having reached historical peak prices, the price of the Californian almond fell down to US$2.50 a pound from US$4.7. But later on, the price rose to US$3 a pound. As a result, the economic weight of the Californian almond became lighter: it is *ca*. US$5.3 billion, after a record value of US$7.3 billion in 2015 (Girard, 2017a).

But despite this fall in the world prices, almond cultivation remains a prosperous industry in the United States. Its marketing arm, the Californian Almond Collective, carries out its gospel work across the world, thanks to advertisement campaigns aimed at enhancing the consumption of the fruit among Chinese, French, Korean and German consumers, and thus seizing the many opportunities of snacking. The mission of the Collective is to eliminate all kinds of criticism. This was the case when California has suffered during four years of drought – it is still suffering from drought and fires every summer; when there was a water deficit or stress, almond orchards were still being irrigated. About 10% of the water consumed in Californian agriculture was used in almond orchards. Four litres of water are necessary for the fruit to ripen, compared with 2.8 l for pistachio and 1.5 l for strawberries. Also, there has been some kind of controversy about the lack of pollinating insects and the subsequent need to rent bee-hives from other regions of the United States or even from as far as Australia, in order to pollinate almond flowers. It has been estimated that 300,000 bees are needed to pollinate one hectare of almond orchards (Girard, 2017a).

Producers of milk are angry at the increasing success of almond milk, used more often in coffee, ice creams or yogurt. It is widely accepted by those persons who cannot tolerate cow's milk. But milk producers retaliate by demanding that the word milk be only used to name the liquid extracted from a bovine udder. California being the first American milk-producing State, there is a growing tension between both sectors of the agriculture and agroindustry. But these sour relationships do not hinder the global consumption of almonds, which is distributed as follows: 32% for the European Union, 27% for the United States, 10% for China, 7% for India, 5% for the United Arab Emirates and 19% for the rest of the world. In France, for instance, the annual consumption of almonds amounted to 25,000-30,000 tons, 96% of which is imported. There is a period of the year, during the Epiphany celebrated in the churches on Sunday 8 January, when French people buy a lot of traditional pastries garnished with almond powder – the key ingredient of the frangipane. It has been estimated that 30 to 32 million pastries are being sold every year in France. This represents 10% of the average annual turnover of traditional bakers; the profit made from the sales of these pastries is *ca*. 20% of total sales, compared with 10% to 15% for all kinds of bread (Girard, 2017a).

SUGARS

Sugar consumption

In one century and half, sugar consumption per person has considerably increased : for instance, in France, it increased from 5 kg per year in 1850 to 26 kg per year one century later. Nowadays (2018), the figure is 35 kg per person per year, i.e. almost 20% of the daily total energy intake. In the United States, the situation is worse: the consumption has reached 60 kg per person per year, according to the figures published by the International Sugar Organization. This is too much: according to the World Health Organization (WHO), the consumption of free or hidden sugars – it does not include those sugars present in fruit and vegetables – should be limited to 10% of the daily energy intake. A healthier behaviour would be to lower sugar consumption to 5% of daily energy intake. The relationships between sugar consumption and health problems have been put aside for a long time, whereas "there is serious evidence that the limitation of daily sugar consumption to 10% of energy intake reduces the risk of obesity, overweight and tooth-cavities," stated in 2016 Francesco Branca, director of WHO department of nutrition for health and development. Some experts qualify sugar as "useless calories" or "empty calories". "Sugar is not necessary from the nutrition viewpoint," stated F. Branca (Santi, 2017).

Health experts are concerned by the fact that obesity is now a widespread disease. This is due, obviously, to a bad lifestyle hygiene, but also to a food intake containing too much fats and sugars: according to WHO estimates the proportion of overweight and obese people was to increase from 47% in 2012 to 67% in 2030. As a result, the number of diabetics would reach 629 million in 2045 in the world, i.e. one person out of ten. In France, Didier Raoult, a microbiology professor and head of a hospital in Marseille (southeast of France), stated in a weekly magazine published in Paris that "sugar is a wholesale poison" and that "its consumption has spread like a real epidemic" (Santi, 2017).

In his book titled *Fat Chance*: *The Bitter Truth About Sugar* (2013), Robert Lustig, a professor of pediatrics in the Division of endocrinology and a member of the Institute for Health Policy Studies at the University of California, San Francisco, who works on childhood obesity, explains that "all calories have not the same value." Added sugar is all around us and is, according to R. Lustig, the prime cause of our ballooning "obesity pandemic." Sugar is a toxic and addictive foodstuff." R. Lustig who has been the former chairperson of the Obesity Task Force of the Pediatric Endocrine Society, is a member of the Pediatric Obesity Devices Committee of the United States Food

and Drug Administration (USFDA) and also the president of the non-profit Institute for Responsible Nutrition, dedicated to reversing childhood obesity and type 2 diabetes. In his book, that was translated into French in October 2017, R. Lustig is angry at the food industry and the regulatory capture of Western governments by its lobbyists. Fructose is denounced by R. Lustig as the culprit of the obesity pandemic. Recent reports elsewhere, indeed, indicate that there is a growing consensus behind the idea that the fructose factor helps to explain what otherwise looks like a puzzle: why do different diets – Atkins, the Paleo diet, the traditional Japanese or Mediterranean diets – all have notable health benefits? Because they are all low-sugar and high-fibre regimes. We consume a lot of ultra-processed foodstuffs and at the same time a lot of fructose and so little fiber. And R. Lustig thinks that it is urgent to adopt a qualitative diet, based on foodstuffs that are not processed at all or not too much: "do eat foodstuffs that are natural, i.e. whole fruit and vegetables rather than the processed products derived from them, such as juices or other industrial foodstuffs." "A glass of orange juice contains more sugar than the equivalent volume of a Coca-Cola drink.

In 2012, Robert Lustig, Laura Schmidt and Claire Brindis of the University of California, San Francisco, have supported a proposal concerning a tax on sweetened products and a strict regulation of their sales. The WHO has also recommended that the marketing (advertisement) of these products should be restricted, especially in the case of children, and that a relevant nutritional labeling should be imposed on them. That was the objective of the decision made in France at the end of October 2017 and aimed at better informing the consumers about the foodstuff nutritional quality. But the lobbying activities of the multinational sweetened-beverage companies and of sugar producers are not easy to counteract, although there are some hopeful changes. (See also pp. 307-308; Lustig, 2013).

Sociological study on the behaviour of girls and boys with respect to sugar

Anne Dupuy (2013), a sociologist at the University of Toulouse, France, authored a book titled *Plaisirs alimentaires. Socialisation des enfants et des adolescents* (Food Pleasures. Socialization Of Children And Teenagers), and on 23 December 2017, in an interview with a journalist of the French daily newspaper *Le Monde*, she stated that all newborns are very much attracted by sugary savours. But the nutritional environments of these newborns – parents or maternal assistants – do not regulate this nutritional behaviour in the same way among girls and boys. If a little boy likes sweet products, he is often perceived as a "good eater", whereas if a girl has the same behaviour she is considered as greedy. In terms of eating and finishing their meals, the perception is also different: a young boy who swallows his food rapidly is perceived as satisfying his hunger, while in the case of girl, it is a sign of pleasure. Thus, the parents adopt different feeding strategies: they tend to influence the food behaviour of young girls more than that of young boys, particularly with respect to sweet savours; young girls are more monitored than young boys (Dupuy, 2017).

Women, female teenagers and young girls are expected to have a moderate relationship with food pleasure, while the reverse is true of men, male teenagers and young boys. This approach has been supported over recent years by the fact that food

intake is increasingly regulated by health concerns, which aim to avoid any excess of food intake and to control the wrong behaviours, especially with respect to sugar and sweets. It seems that nutritional recommendations are stricter for girls than for boys; the former are more afraid of putting on weight, they need to take care of their esthetics and they are medically monitored, particularly by gynecologists. In other words, the health issues regarding food intake are more monitored in girls than in boys, especially with respect to sugar intake (Dupuy, 2017). Regarding the latter, there are significant differences between female and male teenagers: the former ones tend to be more attracted by sweets than the latter. This may be a reaction to the strong pressure imposed on them during their young age: they try to circumvent the rules that targeted them previously. By contrast, adult women show a more moderate behaviour regarding food pleasure than men, especially regarding sugar and sweet savours. Once becoming mothers, they are more aware and more responsible than their husbands or companions regarding the health and food balance of their children. When they feed them, they make efforts to fulfill the recommended nutritional and diet requirements, while the fathers generally adopt a more hedonistic approach and feel more confident: they underline the search for food pleasure – a behaviour that is socially valued among men (Dupuy, 2017).

The bitter history of cane-sugar production: the slave trade

Sugar trade has been at the core of the slave trade which, from the 16th to the 19th century, was the fate of 12-13 million Africans who worked as slaves in the sugar-cane plantations and sugar-production factories. According to the French economist Pierre Dockès (2009), Christopher Columbus, who was formerly associated with a company in Genoa having economic interests in the exploitation of sugar cane in Portuguese colonies, clearly understood that many regions of the New World could be converted into vast sugar-cane plantations. During his second journey, in 1493, he had on board African slaves and sugar-cane plants which he tried to adapt to the climate of Santo Domingo (now the Dominican Republic). Without the trade slave, Europe would have run short of sugar. The latter "was in fact the main raw material of colonial plantations," recalled the historian Pap Ndiaye, a professor at the Institute of Political Science (*Science Po*, Paris).

Sidney W. Mintz (2014), an American specialist of the Carribean, has shown how the consumption of sugar, a material derived from a specific production model – the plantation system – has changed the outlook of the industrial world, starting with the life of English workers since the middle of the 19th century. Sugar, initially an exotic and rare product, extracted from sugar cane, has gone through an extraordinary worldwide expansion since the 16th century, in the footsteps of the Great Discoveries. Initially consumed by the elite, sugar was an excellent marker of social distinction; but over a few centuries it has become a massively consumed good, one of the first-necessity foods. According to S.W. Mintz, sugar has been a major actor as well as a revealer of the history of world capitalism. Published for the first time a the end of the 1980s, S.W Montz's book is considered a classic of anthropology and economic history that paves the way to food studies and global history.

According to the American historian Marcus Rediker, more than 70% of African slaves were purchased for the sugar-cane plantations of the British Caribbean islands. France deported 1.6 million slaves to the Antilles – three times more than the southern States of the United States. "If one would like to put a symbolic label on the colonies, as they are still now, one should put a bundle of sugar canes with a foreman's whip," wrote in 1842 Victor Schoelcher, who struggled in France to abolish slavery. Thanks to the backbreaking work of millions of slaves, sugar became the "white gold" of international trade during the Age of Enlightenment. The profits drawn from the colonies' sugar-cane plantations were so important that in 1763, according to the Paris Treaty, France preferred to abandon the immense territories it had colonized in Canada rather than the "sugar islands" of the Antilles. Sugar production, always dependent on the slaves' work, was increasingly growing: in Guadeloupe and Martinique, it increased from 2,500 tons a year at the end of the 17th century to more than 18,000 tons a year during the 1780s (Chemin, 2017).

Before sugar exports, European populations have been using honey and fruit until the Middle Ages to sweeten some of their foodstuffs and to have a sweet tooth. In the 12th century, when the Crusades took place, France discovered sugar cane: in 1099, the chronicler Foucher de Chartres reported that the Crusaders under the leadership of Baudoin de Boulogne survived hunger thanks to chewing cannamellis – "honey cane". This plant species was domesticated in the Indian subcontinent then cultivated in Syria, Palestine, Egypt and North Africa. It should be pointed out that for centuries sugar was used as a pharmaceutical. "Because of its very high cost, the Medieval West did use sugar as a pharmaceutical," explained in 2016 the agronomist Eric Birlouez. "Such a valued product could only have a healthy impact, people thought." According to the physicians living at that time, "t was a "warm" and "humid" foodstuff. "These properties facilitated the digestion of food, crucial for good health. Therefore, sugar was given first to ill people as well as to weakened convalescent ones, in order to make them stronger again," he added (Chemin, 2017).

As a result of the colonization of the New World, sugar progressively moved out of the medical arena: during the 18th century, it became a fashionable product among the well-off people living in the big towns. For instance, in 1716 in Paris there were 300 coffee-houses, and their number increased up to almost 2,000 on the eve of the French Revolution. In these coffee-houses, "sweetened beverages were not their unique appeal, sherbets and ice creams were also very fashionable, among those who could afford them", explained Catherine Coquery-Vidrovitch and Éric Mesnard (2019). The latter recalled that in Africa, the Carribean and the Americas, slaves have been the major actors, although underestimated, of history. Based on many life stories, their book demonstrates that these slaves have contributed to the cultural and social changes occurring on the coasts and the hinterland of Africa, to the creation of new intermixed societies in the Americas, or they invented new forms of resistance. While uncovering the intensity of exchanges between Africa and the Americas, and also describing the importance of human trafficking in the Southern Atlantic or the generalization of internal precolonial slavery in African societies during the 19th century, Coquery-Vidrovitch and Mesnard (2019) give in their book an enlightening synthesis of the most recent inputs of the international historiography dedicated to slavery.

French people used to appreciate these new delightful products, but did not care about the way of life of the hundreds of thousands of slaves on whom sugar production depended. They had to work from dawn to sunset in the plantations, they suffered from hunger caused by the settlers' miserliness, they lived under terror due to the master's absolute authority, testified by all kinds of torture, including lashes. To try to justify torture inflicted on the slaves, the monk Labat, in 1722, thought that "it was necessary to go beyond the limits of moderation (…) in order to intimidate them and to make them fearful and respectful." In 1685, the *Code noir*, a series of legal regulations concerning the slave trade between France and the West Indies, considered the black slave as a property: it could be purchased, sold or transmitted to the offspring of his master, while they could not make their case in court (Chemin, 2017).

French people living in the 17th and 18th centuries were very far from being concerned by the relationship between the sweet savours they enjoyed and the crimes against humanity committed by their fellow countrymen in the tropics. "Since 1788, the Society for Friendship with Black People, of which Condorcet was a member, has been making a strong plea for the abolition of slavery, but it had difficulty to convince the decision-makers, because of the strong opposition of sugar-cane growers. Finally, in 1831, King Louis-Philippe decided to put an end to the slave trade. By contrast in Great Britain, the abolition of slave trade received people's support by the end of the 18th century. The slogan of the British Society for the Abolition of Slave Trade was: "Am I not a man and a brother?" "Boycott campaigns in Great Britain have been trying, since the end of the 18th century, to stop or drastically reduce sugar consumption which was the output of slaves' blood and sweat," commented Pap Ndiaye. In France, in 1848, a decree of the Second Republic put an end to the terrible suffering of slaves (Chemin, 2017).

Sugar global trade and companies

Since the beginning of 2019, at the New York Stock Exchange, the price of the pound of sugar has been *ca*. US$13 cents, a level which was considered far from profitable for the producers. This was nevertheless lower than the threshold of US$11 cents of 1 October 2018, one year after the end of the European sugar quotas. The resulting free trade of sugar has generated an overproduction crisis, followed by the fall of the price of the raw material. This also induced a new wave of consolidation of the European sugar-beet production chain, especially in France (Girard, 2019f). For instance, the Cristal Union cooperative, known for its brand Daddy, decided on 17 April 2019, to close down two of its ten factories. Cristal Union announced a loss of €99 million in its 2018 turnover, which fell down to €1.7 billion (-16%) [Girard, 2019g]. That was another serious blow after the German sugar producer Südzucker decided to reduce its business in France. It was indeed ready to close down two of the four sugar factories of its French subsidiary Saint Louis Sucre. Regarding Tereos, the leading French cooperative sugar producer, well known for its brands La Perruche and Béghin Say, its executive officer admitted that his group had to close down eight sugar factories in France over the last 20 years; the cooperative group still owned nine of them by mid-2019. Tereos announced on 12 June 2019 a loss of €242 million during the fiscal year ending 31 March 2019. Its annual turnover decreased by 7%, down to €4.43 billion (Girard, 2019j).

It should be mentioned that on 28 December 2018, Tereos had signed an agreement with the Brazilian public-oil company Petrobras, with a view to buying 46% of Petrobras' equity in Guarani, their co-company that produces sugar and agrofuels. Tereos was expected to spend US$202 million or €192 million to become the full owner of Guarani – the third-biggest sugar producer in Brazil (Girard, 2019j). Nevertheless, Tereos' debt amounted to €2.5 billion. In this context, Tereos has put an end to its partnership with the Italian company ETEA, specialized in the production of ethanol, and this decision enabled Tereos to cash €220 million and to reduce its debt by the same amount. Alexis Duval, the president of Tereos' directorate at that time, was also hoping that costs could be reduced by another €200 million thanks to the plan called *Ambitions 2022*, and without closing down any factory. Cristal Union also hoped to improve its financial situation in 2019, despite a net debt of €490 million; the company was planning to reduce its costs by €50 million in a full year (Girard, 2019j).

The shock wave produced by the low price of sugar on international markets did affect the whole French sugar-production chain. The French General Confederation of Sugar-Beet Farmers (*Confédération générale des planteurs de betteraves*, CGB), that included 26,000 members in 2019, took action immediately after the decision made by Südzucker. The French agriculture ministry announced that it was willing to help the farmers. It should be recalled that when the end of sugar quotas was foreseen in 2017, all the industrialists, Tereos, Cristal Union, as well as their German competitors, Südzucker and Nord-zucker, enticed the farmers to increase by 20% the acreage cultivated with sugar beet. As a result, Europe had a record harvest as well as a stock of 3 million tons of sugar. At the same time, the harvest of sugar cane was also bountiful in Brazil, Thailand and India, and consequently the price of sugar fell down on international markets. Also the European sugar manufacturers have seen their balance sheets affected in 2018, because they did not expect the change would happen so rapidly. Thus, by the end of March 2019, Südzucker estimated that its sugar activity would still show a loss of €200 million to €300 million in 2019; in France and to a lesser extent in the rest of Europe, Nordzucker closed down a sugar factory in Sweden and Südzucker closed down two in Germany and one in Poland (Girard, 2019f).

It is still difficult to foresee the changes occurring in the European sugar industry, but it seemed likely that there is some kind of consolidation of the whole business. These changes will also have to do with the lesser consumption of sugar and its derivatives. For instance, more emphasis is laid on the consumption of natural sweeteners, like stevia.

High Fructose Corn Syrup (HFCS)

The high fructose corn syrup (HFCS) is a syrup that looks like a molasse, derived from the fractionation of maize starch. In the early 1960s, when imports of cane sugar from Cuba were forbidden following the embargo imposed in 1960 by the American administration on products imported from the Caribbean island, the United States had to find new sources of sugar. A few years later, Japanese researchers discovered how to fractionate starch into a mixture of glucose and fructose, and how to separate enzymatically glucose from fructose. The syrup resulting from this degradation, when

derived from maize starch, is called High Fructose Corn Syrup (HFCS). Maize (corn), an important crop in the United States, especially in the Middle West, became an important source of sugar. In 1973, President Richard Nixon signed a farm bill that aimed to secure the supply of sugar, derived from maize, and to make the country non-dependent on cane-sugar imports. The farm bill also resulted in the reduction of this kind of sugar production costs (Gérard, 2019b).

In 1980, Allen hurricane caused 269 deaths and devastated almost all the harvest of sugar cane in the Caribbean. As a consequence, the High Fructose Corn Syrup became the alternative to the Caribbean sugar. For instance, Coca-Cola used it in its soft-drink production; its example was followed by many big corporations that also used the syrup. The latter is well packaged and can be stored for a long time; being a liquid it is easily used. In addition, its low cost makes it a very convenient raw material for the industry. The syrup also benefited from the struggle against fats initiated by the public authorities in the 1970s; it was added to low-lipid foodstuffs in order to make them attractive. Therefore, the syrup, with an extended conservation time, is found in soft drinks, biscuits, tomato sauces, but also in sandwich bread to enhance its taste, giving it a brown and appetizing colour (Gérard, 2019b).

Nowadays, 5% of the United States' maize harvest is used to manufacture this sweetener. However, its high content of fructose raises nutritional issues: it is generally as high as 42% or 55%, or very seldom 90%. Glucose and fructose are chemically almost identical and equivalent in terms of calorie input, but they are not metabolized in the same way in the human body. Glucose, transported in the bloodstream, is at the root of many metabolic processes, in addition to supplying energy. Fructose is mainly stored in the liver as fat and it does not induce the release of insulin, thus causing more intake. As mentioned earlier (see pp. 301-302), the American endocrinologist Robert Lustig considers that "fructose induces toxicity in the liver, which is similar to that of alcohol consumption" … and that "fructose is the main cause of chronic metabolic diseases." "Fructose is the precursor of fat, it alterates the intestinal barrier and accelerates the damaging impact of excessive sugar consumption in the human body," stated Anne-Françoise Burnol, a research director at the French National Scientific Research Centre (CNRS, French acronym).

Fructose is naturally present in honey (40%) and fruit (2% to 11%). But why it advisable to eat fruit? Because the fibers in fruit counteract the noxious effects of the sugar; that is why it is better to eat your fruit than to drink it. It is well documented that fibers are destroyed during industrial food processing and consequently the nutritional quality of foodstuffs is poorer. Consumers' associations have criticized the use of HFCS in the food industry and the result of their campaigns was effectively a lower use of the sweetener. But there are also unhealthy substitutes made of sucrose (glucose+fructose) which are part of the ultra-processed foodstuffs or recipes, and which are called "hidden sugars". That is why R. Lustig recommend to get rid of them by challenging the industrial ultra-processing of food which he qualified as "Mister Hyde of the obesity pandemic: any true foodstuff, any natural foodstuff, is intrinsically healthy. It is what we do to foodstuffs that is not good." Consequently, R. Lustig's mantra could be: eat less sugar, eat more fiber, and exercise more. In his book (2013, 2017), R. Lustig provides a

six-page shopping list of low-fructose and high-fiber foods that one can find in any supermarket; and he gives advice on how to behave in a restaurant (do not be in a fast-food point in the first place; do not have bread with the meal; do not order dessert). The crucial issue remains nevertheless whether people can actually change their eating behaviour.

Stevia

Stevia is one of the natural sweeteners that is particularly appreciated in Japan. It has been used by Guarani Indians, since the Precolombian era, to decrease the bitterness of *maté* and other medicinal beverages. That is why they called it *ka'a he'ê* or "sweet herb". It grows in the subtropical forests at the border of Paraguay and Brazil; it belongs to the Asteraceae family (like chicory or dandelion), it likes sunshine and can reach a height of more than one meter; it flowers in August. By the middle of the 16th century, this plant species has been described by the Spanish botanist Petrus Jacobus Stevus. Three centuries later, in 1887, Moisés Santiago Bertoni, a Swiss that had migrated to Paraguay, noticed the sweet taste of the plant. In 1931, two French chemists could isolate the natural chemicals which give the plant its sweetening power: rebaudioside A and stevioside. The plant species has been named *Stevia rebaudiana bertoni* – an association of the names of its discoverers and one of its chemical compounds (Joignot, 2017).

During the following decades, several studies have described the remarkable characteristics of stevia. The sweetening power of its leaves is 30 to 45 times higher than that of sucrose extracted from sugar beet or sugar cane. In terms of sweetening power, leaf extracts taste even 300 times more than sucrose. Its sweet savour remains in the mouth, it resists to a temperature of 200°C and it can therefore be cooked. Moreover, its low content of carbohydrates makes it a low-calorie sweetener, which has an almost nil impact on the glucose content in the blood. Therefore, physicians, health-care authorities and food companies have understood that stevia could be a healthy substitute for sucrose, which would control tooth-cavities, overweight and hypertension, but also could become part of the diabetics' diets, i.e. hypoglycemic diets. In other words, stevia brings the pleasure of a sweet savour that the human species has been appreciating for the last 10,000 years, but without its main physiological drawbacks. The industrial exploitation of stevia began during the 1950s when Japan started to cultivate it. In 1969, Japan prohibited the use of synthetic sweeteners such as aspartame, the long-term effects of which are not well known. During the 1980s, Brazil, Australia and China started to grow it. But in the United States, in 1991, the Food and Drug Administration (FDA) blocked its development further to an anonymous complaint about its possible harm. But another enquiry carried out by an FDA inspector revealed that these were just rumours by aspartame producers. In 2008, the World Health Organization (WHO), on the basis of the data regarding its use in Japan and Paraguay, stated that the plant was innocuous and offered obvious benefits (Joignot, 2017).

Coca-Cola has commercialized a new beverage called *light* and sweetened with stevia. By the end of 2015, the multinational was under the attack of several Guarani leaders

in Brazil – nowadays there are *ca*. 80,000 Guarani Indians, according to the Conselho Indigenista Missionario (Indigenous Missionary Council), whose ancestors used to live in symbiosis with the forest in the Amazonian regions of Paraguay, Brazil and Bolivia. With the support of several NGOs, they signed a petition accusing Coca-Cola of plundering their biological and genetic resources, and demanding that a financial compensation be allocated to their communities. Paraguay has decided that stevia was part of its "genetic-resource heritage" and it tries to commercialize the shrub's leaves. But the sweetened-beverage multinationals reacted by achieving the chemical synthesis of stevia sugars and they patented the process (Joignot, 2017).

Physiological action of artificial sweeteners

Researchers working at the German Institute of Human Nutrition recently discovered that a mixture of cyclamate and saccharine not only activated their respective receptors located on the tongue buds, but also that saccharine could block the cyclamate receptor as well as the bitterness of cyclamate, and *vice versa*. It is a natural inhibition, but the end result is a sweet savour in the mouth. It should be recalled that human beings are generally equipped to detect bitterness – e.g. that of cabbage –, even at very low concentrations. There are on the tongue taste buds *ca*. 25 receptors that can detect bitterness, while there is only one receptor for detecting sweet savours; in fact this receptor needs a lot of sugar or sweetener to be activated. Why such a difference? It is assumed that the susceptibility to bitterness can protect human beings against potentially toxic molecules. In other words, to avoid poisoning one must be able to detect very low amounts of these molecules. By contrast, we are not susceptible to sweeteners (sweet savour), and we need to consume a lot of sugar – a main energy supplier to the body which can be stored for that purpose. But consuming too much sugar can lead to diabetes and obesity. How to mitigate such a risk?

The agrifood industry designed research programmes to find synthetic sweeteners and thereafter trying to disseminate their general use. That was the case of cyclamate and saccharine, whose sweetening power was respectively 30 and 400 times higher than that of sucrose. But these artificial sweeteners had the advantage of not bringing in energy, but leaving nevertheless a sweet savour. However, they had a drawback: they left an unpleasant bitter aftertaste. The reason was that these sweeteners activated not only the sugar receptor of the tongue taste buds, but also those of bitterness. The sweeteners can hide the bitter savour in the mouth, but not for a long time. Thus, the researchers of the agrifood industry concluded that the combination of cyclamate and saccharine can solve the problem, but they ignored the basic physiological reason. The German researchers' findings could at least explain the relationship between our sensorial perception with the functioning of the tongue taste-bud receptors. The technology, developed further to the research work at the German Institute of Human Nutrition, attracted the interest of the agrifood industry, which is racing to discover new sweeteners through testing already known molecules or new ones.

OILS

The olive industry under threat

A bacterial epidemic wreaks havoc upon southeastern Italy's olive groves

Italy is the world's second-biggest producer of olive oil (in terms of volumes), just behind Spain, with *ca*. 250 million olive trees cultivated on 1.1 million hectares. Italian olive-industry had a turnover of €2 billion in 2013 and contributed €1 billion to the balance-trade surplus. This industry endured a terrible year in 2014 from bad weather and a nasty infestation of the olive fruit fly, which caused a 35% decrease in total olive-oil production as well as an almost equal rise in the price at the level of oil presses. Paradoxically, the imports of lower-grade olive oil from Spain, Greece and North Africa had risen to meet the demand – each Italian consumes *ca*. 10 liters of olive oil a year (Ridet, 2015a). Another bacterial outbreak is threatening European olive-tree groves, and, to some degree, Europe is simply now facing a problem that was long entrenched in the Americas. One study estimated that Pierce's disease – a strain of the bacterium *Xylella* that affects grapes and vineyards – costs California more than US$104 million a year. Farmers in Brazil which produces *ca*. 60% of the global citrus juice supply, face similar problems. "They have essentially learnt to live with a very high prevalence of *Xylella*," stated Rodrigo Almeida, an associate professor of environmental science at the University of California, Berkeley (Pianigiani, 2015).

The bacterium, *Xylella fastidiosa*, steadily restricts water from the roots of a tree to its branches and leaves. The spittlebugs and cicadellae which will start flying in May, have served as a primary vector of the outbreak in Southern Italy, chewing on the leaves of infected trees and then carrying the bacterium to other, healthy trees, like an unseen wild fire. Scientists state that no one yet knows the extent of the outbreak because some infected trees may not yet be showing symptoms. The olives are not affected, but production gradually diminishes as a tree dies. Since the detection of *Xylella fastidiosa* in 2010 in the southeastern province of Puglia, the region that includes the Salento, not only Italy but the whole Mediterranean Basin, from Greece to Spain through the south of France, were in high alert, because of the possible contamination of the olive-tree groves by the bacterium. At the end of April 2015, the European Commission had enforced preventive measures such as the eradication of whole groves of olive trees in the infested zones, carving a buffer zone of 20 km in the north of the contaminated area and the embargo on the export of olive-tree saplings that might be infected. To prevent the bacterium from spreading north, Italian officials were trying to quarantine the outbreak in the lower half of the Salento, where most of the contaminated trees

were located by carving a buffer zone that would serve as a sort of biological firebreak. The European Commission, in Brussels, had backed off earlier proposals to cull millions of trees in the Salento and instead endorsed the Italian buffer zone as well as other monitoring measures north of the peninsula. And France has moved to protect its vineyards by banning the imports of certain species of plants from Puglia. "The most important thing is that the disease should not spread to the north," said Enrico Brivio, a European Commission spokesman in 2015 (Pianigiani, 2015; Ridet, 2015b).

In the southern half of the Salento, the hardest-hit areas surround the coastal town of Gallipoli and radiate southward, towards Racale and then down to the tip of Italy. From Gallipoli to Tarante, through the three zones of "war" – the frontline in the province of Lecce, the buffer zone of the province of Ostuni and the rear battlefield in the neighbourhood of the town of Bari –, Italian officials that olive growers had accused of reacting too slowly, had divided the affected region into quarantine areas, with the buffer zone extending across the peninsula. Infected trees and plants were supposed to be cut down, in one of the quarantine areas north of the buffer zone, while growers in the contaminated region south of the buffer zone were supposed to prune infected trees and cut surrounding grasses to better control insect vectors. Italy's agriculture minister stated that at most *ca*. 35,000 trees could be uprooted under the government plan – out of an estimated 11 million olive trees in the area (Pianigiani, 2015; Ridet, 2015b).

Growers noted on their side that *ca*. 10% of all olive trees in the southern part of the Salento were infected – meaning that *ca*. 10 million trees were still thought to be healthy. "Our main goal is to save Salento from the bacteria," stated a producer and head of a consortium of olive growers. "We need to coexist with it. Eradication is not a feasible goal," he added. Scientists also stated a buffer zone may be useful but warned that simply cutting down infected trees will not solve the problem in southern Salento. "The only feasible option is coexistence – and to create an open-sky laboratory in that area," stated Donato Boscia, a scientist at Italy's National Research Council. In southern Salento, growers were determined to learn how to adapt to the presence of the bacterium. It takes seven years or longer for a new tree to begin producing olives, and that is why farmers were initially furious at reports that the European Commission wanted to cut down one million or more trees, and possibly even healthy plants in their vicinity. Another issue was who will cover the economic losses due to culling the trees. The Italian agriculture minister said €11 million or *ca*. US$12 million would be made available to help the growers. But the economic effect on Puglia could be much worse. Most of all olive growers feared that a way of life that had sustained generations could disappear (Pianigiani, 2015).

In February 2015, the Italian government appointed the former mayor of the *Corpo Forestale Dello Stato* (State Forest-Protection Body), Giuseppe Silletti, as Special Government Commissioner in charge of combating the outbreak of *Xylella fastidiosa*. In an interview with the French daily newspaper *Le Monde*, he explained in August 2015 what he tried to do "with his 140 men". "They "cleaned" the red zone, that of the Lecce province, which was hardly hit by the bacterial killer. They built 1,200 km of roads or tracks and 230 ha of public gardens; 60,000 ha of olive-tree groves were recovered. That will not prevent the treatment of trees with chemicals" (Ridet, 2015b).

Causes of Xylella fastidiosa outbreak

A first assumption was that the bacterium arrived with plants imported from Costa Rica. It landed in Rotterdam, Netherlands, and from there it reached the olive nurseries of the province of Lecce, Puglia. The second assumption concerned an Italian origin: the bacterium was brought in during a congress organized in 2010 in Bari by the Mediterranean Higher Agronomic Studies Centre (CIHEAM, French acronym). That was done by scientists which were discussing the damage the bacterium could cause and the possible remedies against its spreading. But it seems difficult to prove that the bacterium studied by the experts is the same as that which wreaked havoc upon south-eastern Italy's olive-tree groves. A third scenario was mentioned: a criminal hand would have disseminated *Xylella fastidiosa* in the province of Lecce, where are concentrated small groves, so as to ruin them and replace them with large touristic sea-shore residences. Who could have been such criminals? Olive growers from Bari, the regional capital of Puglia, where olive-tree groves are more prosperous and olive oil is of better quality and more expensive? Elected people at the service of multinational companies involved in agrifood chemistry? Promoters of intensive agriculture who would like to eliminate organic agriculture? (Ridet, 2015b)

As often in Italy, official statements, issued by the political authorities or by scientific experts, are often suspected to serve personal interests and were therefore systematically questioned. For instance, those who propose to cull the trees are considered as "war profiteers" who were accused of hoarding the amounts of money allocated to help the growers. Conversely, the ecologists who wanted to save the trees are accused to propagate the plague. Moreover the experts from Lecce were complaining that there was no cooperation with their colleagues from Bari and the universities of Basilicate, the nearby province. Some judges in charge of the enquiry regarding the origin of the bacterial killer, considered that the regional sanitary bodies did not take the adequate measures at the outset of the epidemic or they had neglected its first symptoms. The first cases of infection may go back to 2008 (Ridet, 2015a,b).

Meanwhile, each grower has his solution to combat the bacterium. Some organic farmers, referring to the work of an agronomist of Matera, recommend the fertilization of the soils with organic matter, the recurrent cleaning of these soils, the pruning of dead twigs as soon as young shoots appear at the bottom of the tree, in order to maintain it in good health. In Racale, a few kilometers from the core of the outbreak, one of the founders of the association *La Voce Dell' Ulivo* (The Voice of the Olive Tree), Federico Manni, was promoting another treatment: to graft on the slightly affected olive trees scions from another olive-tree variety, more resistant to the bacterium and coming from Tuscany. F. Manni was the manager of an olive-tree cooperative that included 800 smallholders who had an annual output of 30,000 litres of oil. It should be mentioned that in Puglia olive-tree groves are transmitted from one generation to the other; a few hundred trees, sometimes less, that can meet the olive-oil needs of a family and friends. That is why in this region everyone considers he had a personal commitment to save the trees, because the latter are part of the growers' life and not just trees. A former president of the Puglia region, Michele Emiliano, elected on 31 May 2015, stated in this regard: "These olive trees are for us what seals are for Eskimos."

Some 268,000 olive-tree growers, small or big, and 60 million trees were concerned by the decisions to be made regarding the various means to combat the bacterial killer, including the culling of trees. Some of these are 2,000-years old or more; they have seen the Greeks, the Roman Legions, the Phenicians, the Byzantines, the Normands and the Swedes passing by; they have withstood fires and thunderstorms, and they have survived (Ridet, 2015b).

Xylella outbreak in Corsica

In Italy, the infestation of olive trees by *Xylella fastidiosa* had started in 2010, around the town of Gallipoli, in Puglia, then it had spread northward, near Lecce; and it had reached Brindisi, or beyond that town. At a distance of less than 1,000 km from Corsica, in the Italian southeastern province of Puglia, the bacterial killer had destroyed thousands of olive trees, its transmission being carried out by tiny insects, the froghoppers and cicadellae, which thrive on the olive-tree leaves. Therefore, Corsica was within the reach of the bacterial killer. On Saturday 18 April 2015, Joseph-Marie Bové, 86 years old at that time, a research director at the National Agricultural Research Institute (INRA, French acronym) who has been studying *Xylella* for 20 years, sounded the alarm before one hundred persons. Also present on the podium were F. Manni, a manager of the olive cooperative of Racale, a village near Lecce, in Puglia, as well as Agnès Simonpietri, a territorial elected representative of the movement *Femu a Corsica* ("Let us make Corsica"), a moderate nationalist movement (Barroux, 2015a).

"This bacterium infects almond trees, prune trees, citrus, rosebay (oleander), rosemary, myrtle, vines and coffee trees …," has indicated M.J. Bové. In other words a very large part of Corsican vegetation. *Xylella* is infecting both cultivated species – such as tangerines – and wild ones. "The bacterium has been found in the wood vessels of the host plants, where flows the raw sap coming from the roots. All the insects which feed on this sap must therefore be considered as vectors of the disease." The end result of this infection is that the plants die from asphyxia. J.M. Bové had discovered several subspecies of *Xylella* and the number of their host plants reaches, according to him, 309 species. And the main insect vector, the froghopper, is present in almost all European countries. Daniel Sainte-Beuve, one of the executives of the Corsica Office for Agricultural and Rural Development, when interviewed by the daily newspaper *Corse Infos* on 13 April 2015, stated bluntly: "The spread of *Xylella* would be an environmental earthquake." Another state representative was of the opinion that if *Xylella fastidiosa* spread into the island, the crisis would be as devastating as the *Phylloxera* proliferation that destroyed almost all French vineyards at the end of the 19th century (Barroux, 2015a).

On 4 April 2015, the French agriculture ministry took the measure forbidding the imports of plants that may be infected by *Xylella* and coming from the areas hit by the bacterial killer. Most of the plants imported into Corsica used to come from Tuscany, but the provenance of some of them might be Puglia. The battle against *Xylella* had been launched according to the objectives set up by Michaël Lecat, director of the Regional Federation for the Defence against Harmful Organisms: "If *Xylella* is present in Corsica, our objective is to detect it as soon as possible and to destroy it before

its proliferation. The boundaries of the infested area must be circumscribed, this area should be treated, the contaminated plants should be uprooted, a buffer zone must be established and the latter should be monitored for five years." On 8 September 2015, 68 locations that were a source of infestation by *Xylella fastidiosa* had been identified in the island by the local authorities. Almost all of them were ubicated along the seashore in South Corsica, a single one being in the north, in Furiani, near Bastia (department of Haute-Corse). This situation was presented to the Regional Council for the Orientation of Animal and Plant Sanitary Policy (CROPSAV, French acronym for *Conseil regional d'orientation de la politique sanitaire animale et végétale*) that was convened in Ajaccio. The experts, requested by the agriculture ministry to study the outbreak (that occurred on 20 July 2015), came to the clearcut conclusion: the strain of *Xylella* that was identified in Corsica is different from that which destroyed several hundreds of thousands of olive trees in Puglia. It is the strain called *multiplex* and not *pauca* which wreaked havoc on the southeastern Italy's olive-tree groves (Barroux, 2015c).

Most of the infested areas contained the myrtle-leafed polygala (*Polygala myrtifolia*). But it seemed that no crop species was attacked by the bacterium. Consequently, the growers of olive trees, tangerines or chestnuts, who were initially fearing a massive contamination of their tree crops like in Italy, could be relieved. The scientists that worked on the presence of *Xylella multiplex* in Corsica have presented a scenario of *vertical* and not *horizontal* contamination, i.e. genetic and not by vector insects. Out of 11 species of insects that could transmit the bacterium, six have been scrutinized and did not contain any trace of *Xylella*. The plants would have been contaminated before their arrival into Corsica. That remains to be proved. Contamination could occur via the propagation of plants through cuttings, roots or pruning shears. The scenario of the possible presence of two distinct strains of *Xylella* in Corsica was not excluded, and analyses were being implemented in the laboratory of the National Agency for the Sanitary Safety of Food, Environment and Work (ANSES, French acronym for *Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail*) in the city of Angers, centrewest of France (Barroux, 2015c).

"This research work is crucial because it can support the request made at the European Community level for adapting the control strategy regarding the new strain *multiplex* and especially the eradication of host plants in the infested areas," explained Emmanuelle Soubeyran of the agriculture ministry food directorate. "It is necessary to identify for each strain of the bacterium the additional plants that could be contaminated, as well as new vector insects." In Corsica, the growers of crop species kept requesting the total prohibition of any introduction of plants into the island. According to local authorities, all the requests made by nurseries or by landscapers had been rejected since 20 July 2015. The issue remains, however, how to help those professionals whose activity had come to almost a complete standstill (Barroux, 2015c).

Control of Xylella in southeastern France

In 2015, the subspecies *pauca* of *Xylella fastidiosa* has been detected in a myrtle-leafed polygala in the park of Menton, a city of southeast France, near the Italian border and close to the city of Nice. In this one-hectare park, live *ca*. 360 plant species, it was the first area where the subspecies *pauca* of *X. fastidiosa* had been detected in an

olive tree. The so-called Carnolès palace gardens – the former summer residence of the Grimaldi counts – has also been the place where a pluricentennial olive tree was uprooted at the end of September 2019 because it was infected by the bacterium. Another two nearby olive trees were also uprooted in order to prevent any risk of propagation of *Xylella*. Since 2015, "the park has been monitored visually every month and samples have been examined every three months," explained Laurent Lasne, in charge of the agriculture, food and forestry directorate (DRAF, French acronym) for the PACA region (PACA, French acronym for Provence-Alpes-Côte d'Azur region). Furthermore, "There is an equivalence between the bacterium detected in the Italian region of Puglia and that found in Menton; the situation must be taken seriously, even though it seemed under control," added Anne Bronner, an adviser at the cabinet of the agriculture and food minister. In fact, "Didier Guillaume, the minister at the time, has been following very closely this phytosanitary warning," since the beginning of September 2019, when two ornamental olive trees were found contaminated by the bacterium, one in Menton and the other one in Antibes – two cities located in the Maritime-Alpes department (Barroux, 2019).

Plant species that may be contaminated by *Xylella* have been uprooted within a radius of 10 meters around the diseased trees, as it is required by the European regulation. Moreover, the monitoring of the area has been reinforced, including monthly visits to the contaminated site and sampling the plants in order to identify any pathological bacterium. Monitoring has been also carried out in a broader area, called the "buffer zone". Scientists were wondering why or how a bacterium, already detected in 2015, has become active four years later at the same location, despite a periodic monitoring. *Ca*. 40,000 samples taken from ornamental, wild, aromatic or cultivated plant species have been examined since the first detection of *X. fastidiosa* on the French territory (France and Corsica) in 2015. "Out of this number of samples, 5.5% were contaminated by the subspecies *multiplex* in Corsica and 2% in the PACA region were also contaminated by the same *multiplex* subspecies; the *pauca* subspecies had been detected in 2015 and 2019 only in the PACA region," explained Philippe Reignault, director of ANSES phytosanitary laboratory, ubicated in Angers (Barroux, 2019a).

Twenty-five persons are working under the Regional Federation for the Control of Harmful Organisms – PACA (FREDON, French acronym for *Fédération régionale de défense contre les organismes nuisibles* of the PACA region), in the southeastern departments of France affected by the bacterium. They monitor 150 sites infected by *Xylella* and 16,000 sample analyses have been made in the area – 28 plant species were found infected. " We monitor the agricultural crops with the assistance of the National Agricultural Research Institute, over the last four years: vineyards, citrus, plum and almond orchards, lavender, and more closely the olive-tree groves," indicated Marc Binot, director of the FREDON-PACA. "Thanks to the phytosanitary passport, it is checked that no plant is imported from the contaminated area; passengers on board of ferries coming from Corsica are also checked in order to make sure that they do not carry any plant organ ..." Random checks are also carried out in plant nurseries as well as on all roads and paths coming from Italy. However, all these monitoring operations did not eliminate the concerns of olive growers. For instance, a farmer who owned a 10-hectare grove of olive trees, located a few kilometers northeast of Nice,

was very anxious about the likely uprooting of possibly-contaminated plants among her 1,200 to 1,300 olive trees; these produce an olive oil having a Nice appellation of protected origin (AOP). "If tree uprooting was to be decided, it would be a disaster. And if 80 olive trees were found infected in the area, the whole Nice-AOP would be threatened," she stated (Barroux, 2019a).

European Commission's action

The European Commission aimed to intensify and generalize the control of the invasive strains of *Xylella*, even though the most drastic measures had not been considered. On Tuesday 28 April 2015, the experts of the 28 countries of the European Union attended a meeting of the Permanent Committee for Plants, Animals, Food and Feed for Animals, and they decided to strengthen the measures concerning the prevention of the introduction and dissemination of the bacterium. The European text suggested to forbid the introduction of any coffee plant imported from Honduras or Costa Rica, "because of the high risk to be infected by the bacterium." The three coffee cuttings that were analyzed and found contaminated on 15 April 2015 at Rungis, in the south of Paris, had been imported from Costa Rica via the Netherlands. The experts also recommended a "strict eradication" in any infected zone, i.e. the destruction of all host plants such as citrus, olive trees, vines, prune and almond trees, tobacco, rosebay, and oaks, etc., within a radius of 100 m from the plant infected by *Xylella fastidiosa*, and whatever would be the host plants' phytosanitary status (Barroux, 2015b).

But no specific decision was made concerning Italy. The French agriculture minister stated: "We reaffirm our support for Italy as well as our solidarity with its producers." It was out of the question to blame a Member State (Italy) that was angry at the measures already taken unilaterally by France. The representative of the state authority in Corsica was supposed to take measures concerning the conditions of introducing plants imported from Sardinia and southern Italy. Some of those who attended the CROPSAV meeting on 8 September 2015, thought that a prohibition of all plants imported from the southeastern tip of Italy should be decided, as well as the creation of control and quarantine areas in one or two harbours of the island. "France could bring at the European Commission a request for a protected zone, Corsica for instance, if it were estimated that isolation will warrant its protection," was suggested by the French agriculture ministry. For the time being, in the south of France, all growers as well as private owners of orchards, were extremely concerned. The number of tests identifying *Xylella fastidiosa* and performed in all kinds of plants that might be contaminated by the bacterium had increased very significantly; particularly at the Angers laboratory – the only one having the competence to carry out these tests with the hope that these measures will help prevent the outbreak of *Xylella fastidiosa* in Corsica and the south of France (Barroux, 2015b).

Morocco's olive oil: a growing production and a steady increase in quality

On 25 May 2017 was held in Meknès – an important town in the centrenorth of Morocco and the core of an agricultural area renowned for its olive-tree groves and vineyards – the 9th edition of the premium trophy called the *Volubilis extra-vierge*

2017 (Volubilis Extra-Virgin Olive Oil 2017); Volubilis is a well known archaeological small town, a few tens kilometers from Meknès. The purpose of the event was to award a prize to the best extra-virgin olive oil produced in Morocco. The 9th edition 2017 was organized upon the initiative of the Olive Agropolis of Meknès. Agropolis includes several research teams in agronomy and related sciences and technologies, as well as organizations and associations of producers of a variety of agricultural fresh produce and foodstuffs; there are several Agropolis in Morocco which aim to enhance research, development and production. The 9th edition 2017 has been organized in partnership with the: Union for the Development of the Olive Tree of Meknès (UDOM, French acronym for *Union pour le développement de l'olivier de Meknès*); International Foundation for the Roads of the Olive Tree in the Mediterranean; Mediterranean Network of the Olive-Tree Cities (RECOMED, French acronym for *Réseau méditerranéen des villes de l'huile d'olive*); Foundation "Olivier Promo Meknès"; company LCM-Aïcha and the Italian group Pieralisi. This competition which aims to test the quality of Morocco's olive oil and to award a series of prizes to the best ones, was held under the supervision of an international jury. The presidence of the latter has been held, since the beginning of the contest, by Franca Camurati, a renowned international expert in the tasting of higher-quality olive oil (Saad Alami, 2017).

The rest of the jury included ten international experts from Italy, Spain, France, Germany and Brazil, all recommended by the International Olive Council (IOC) and representing the biggest companies that buy and sell olive oil in Europe. For instance, the Italian company Monini was represented; it commercializes more than 120,000 tons of olive oil annually, i.e. the equivalent of Morocco's annual production. During the 9th edition 2017 were competing 25 brands of olive oil produced in several regions of Morocco. The competition has become since 2007 a reference for the quality of the country's extra-virgin olive oil and it has enhanced the recognition of this quality at the regional and international levels. According to Franca Camurati, the results of the 2017 competition highlighted the awards given to Moroccan olive oil at the international level, e.g. their mention in the Italian Guide Flos Olei, that has been listing the best olive oils across the world since 2007 (Saad Alami, 2017).

In addition to an ambitious programme aimed at planting 1 million hectares of olive groves across Morocco, the quality of its olive oil is steadily improving, especially that of the Picholine olive variety produced in the region of Meknès. The olive oils that received a prize in 2017 were presented at the International Extra-Virgin Oil Fair, Expoliva (Jaen, Spain, 10-13 May 2017) and at the World Olive Oil Exhibition (Madrid, March 2017). The Volubilis Extra-Virgin Olive Oil trophy has been awarded to "Volubilia" olive oil in the category *Fruity Intense*, produced by the company Olivinvest of Meknès (Golden Olive Branch), and to the olive oil produced by the company Maasser Brahim Zniber (Silver Olive Branch). In the category *Fruity Medium*, the first prize has been awarded to the oil Elyxus Prestige of the company Olea Capital of Meknès, and the second prize to the olive oil Akalia of the Nebatou Fund, Meknès. Finally, the prize *Ibtissam Zine Filali* was awarded to the Regraga cooperative, region of Essaouira – a town along the Atlantic seashore, south of Casablanca (Saad Alami, 2017).

Palm-oil production and deforestation in Asia

On 19 September 2018, Greenpeace International published a 194-page report titled *Final Countdown – Now or Never to Reform the Palm Oil Industry*, where it stated that palm-oil production for the agrifood and cosmetic industries was still contributing to deforestation in Asia. Indonesia supplies 55% of global palm-oil production and, with Malaysia, they provide 85% of the world's total. There is a growing demand for palm oil, a cheap material and easy to use in the manufacture of agrifoods and cosmetics. The deforestation, which Greenpeace International denounces, destroys not only lush flora and wild fauna, but it also affects the human autochtonous communities living in and from the forests. In addition, the immense fires, set out to transform an increasing forest acreage into new oil-palm plantations, are a source of a vast air pollution that affects not only Indonesia, but also nearby countries; sometimes, airports have to be closed down because of the lack of visibility.

In December 2013, the world's biggest palm-oil trader, Wilmar International, made a commitment to "no deforestation, no peat, no exploitation"(NDPE). Wilmar's chief executive officer (CEO) at that time, Kuok Khoon Hong, promised that within two years the company would only be trading palm oil from responsible producers that protected the environment and respected human rights. Other traders and their customers followed suit, and within a year major traders of Indonesian palm oil – and the brands they supplied – had published NDPE policies of their own. Since the end of 2014, all the conditions have been in place to make "no deforestation" the new norm for the palm-oil industry. The overwhelming majority of Indonesian and Malaysian palm oil passes through companies that have made a commitment to forest protection; recent analysis suggests that traders with NDPE policies operate 74% of the total refinery capacity in Indonesia and Malaysia. Yet, deforestation for palm-oil production shows few signs of slowing down – because although brands and their suppliers have these policies, they have failed to implement them effectively. Years after announcing their NDPE policies, brands and traders are still falling at the first hurdle by failing to identify the producer groups in their supply chains and monitor them across their operations. In many cases, companies are sourcing palm oil from a producer's mature plantations while the same business is destroying forests for new plantations elsewhere. Yet, brands and traders do not have – and do not require their suppliers to provide – the concession maps that would show whether the producer groups that supply them are compliant with their NDPE policies or are still clearing forests (Greenpeace International, 2018).

Despite promising to clean up their supply chains by 2020, brands and their suppliers are still sourcing palm oil from producers that destroy rainforests. Greenpeace International report documents extensive deforestation and human-rights abuses by 25 palm-oil producer groups, all but one of which have supplied brands with palm oil in the last 12 months (including big international groups such as Colgate-Palmolive, General Mills, Hershey, Kellogg's, Kraft Heinz, L'Oréal, Mars, Mondelez, Nestlé, PepsiCo, Reckitt Benckiser and Unilever). Between them, these producers are known to have destroyed more than 130,000 hectares of forest and peatland since 2015, an area almost twice the size of Singapore – and that is almost certainly an

underestimate of the full scale of devastation, because the total size of their collective landbank is unknown. Forty per cent of this destruction – 56,000 hectares – took place in Indonesian Papua (Irian Jaya), one of the world's richest biodiversity regions and the newest front in the palm-oil industry's war against the environment. As the world's largest palm-oil trader – and the first to publish an NDPE policy – Wilmar International bears much of the blame for the ongoing destruction of Indonesia's rainforests for palm oil (Greenpeace International, 2018).

Greenpeace International report was the result of its cartography teams that treated satellite images and analyzed the available databases – in particular those of the Indonesian environment and forestry ministry; furthermore, the NGO carried out field work in order to check the facts. For instance, the NGO presented the case of the family Hardaya Plantation Group. Its founder and CEO, Siti Hartati Murdaya, has been sentenced in 2013 to 30 months of jail and to pay a fine of US$15,000 or €13,000, because of having bribed Sulawesi authorities in order to obtain forest concessions in the centre of the island. A local NGO, Aidenvironment, estimated the total concession amounted to *ca*. 145,000 hectares. American satellite images and government maps also showed that Hardaya cleared up 434 hectares for establishing its own oil-palm plantations between 26 December 2014 and 8 March 2018. The agroindustrial Mars group told Greenpeace International that it had excluded Hardaya from its list of suppliers (Valo, 2018).

In its report, Greenpeace International stresses that the future of the palm-oil industry and other sectors depends on their adoption of a new model of trade based on radical transparency, independent verification and zero tolerance for deforestation and human-rights abuses. In this respect, a certification called "sustainable palm oil" has been adopted by the industrial sector. On 26 June 2018, the members of the Roundtable on Sustainable Palm Oil (RSPO) met in Paris and, on that occasion, a few representatives of indigenous communities coming from Colombia, Indonesia and the Democratic Republic of Congo briefly expressed their claims regarding how the palm-oil industry was affecting their lives. Wilmar International – the world's biggest trader of palm oil based in Singapore – which commercializes *ca*. 43% of the world's palm oil, must lead from the front, according to Greenpeace International. It must prove it no longer sources from forest destroyers, by requiring all producer groups in its supply chain to publish mill location data and concession maps for their entire operations, and cutting off any that refuse. Wilmar must then completely transform its supply chain, so that by 2020 it is only trading with producers whose entire operations have been independently verified as compliant with all aspects of its NDPE policy – even if that means it must sell less palm oil. Wilmar International had been certified RSPO since 2005, and in 2013 its CEO promised to supply the market with deforestation-free palm oil. The Forest Trust (TFT) NGO announced in a press release that Wilmar International presented by 30 September 2018 "a new action plan aimed at filling the gaps in their implementation policy." With 2020 less than 500 days away, the final countdown has begun, as stated by Greenpeace International (2018).

DAIRY PRODUCTS

Causes of butter shortage in 2017

By the end of 2017, supermarkets shelves in parts of France have been bereft of the butter that sustains French cooking and baking, not to mention the Gallic pleasure of a *galette au beurre*. Butter shortage can shake the foundation of France's cultural identity. What is behind such a shortage? Some analysts were blaming consumers since, not surprisingly, warnings of an impending shortfall and rising prices, caused a run on butter in the stores, particularly in the north and west of France. Which is why the shelves were suddenly empty. But even if supermarket supplies do begin to stabilize, the French will probably pay dearly. With increasing global demand for butter, prices have soared, rising to nearly US$8,000 a ton in September 2017 from roughly US$2,800 in April 2016. For their part, consumers put the blame for the shortage on suppliers that, lured by higher profits in the global butter market, were not honouring their contracts with domestic retailers. In their turn, butter makers and suppliers were calling on farmers to increase their dairy herds to meat demand. But Magda Tjerks, who operated a farm with her husband in the Hautes-Pyrénées, southwestern France, stated that this was impossible because the higher profits in the butter trade were not being passed to farmers who provided the cream for making butter. It would be easy to conclude that the shortage was a result of price wars and milk shortages created by dairy-industry manoeuvers, including the slaughter of more than one million cows in Europe in 2016 when milk prices bottomed out (Khosrova, 2017).

But there is another more intractable – and universal – trigger for the dairy shortfall: climate change. France might be a casualty in 2017, but all butter-loving countries are vulnerable to the climate catastrophes that can wreak havoc on the supply and quality of crops needed to feed milk-making animals. During the summer of 2017, heat waves devastated France's grass-fed dairy regions. Given less and poorer-quality grass, the cows made less milk, and that milk's fat content also declined, making less raw material available for butter making. According to Laura Hernandez, an animal lactation expert at the University of Wisconsin, heat stress, caused by the prolonged high summer temperatures associated with climate change, suppressed a cow's appetite, causing it to eat less and give less milk. At the same time when high heat and droughts were plaguing European dairy areas, in Australia and New Zealand, where herds typically would have filled the milk gap, sizzling weather lingered. In other words, climate change created good conditions for a real shortage of butter (Khosrova, 2017).

For those who operate large dairy farms, the paradox is built into their business model. That is because cows need crops or grass to feed on, yet are "factories" of the greenhouse-effect gases, methane and carbon dioxide, which endanger those crops by raising global temperatures. Moreover, conventional dairy farms rely on shipped-in animal feed, such as maize and alfalfa, which are produced using tons of pesticides and fertilizers, and transport using carbon-polluting fossils fuels. So when industry experts declared, as they had in Europe, that the way to restore butter-market stability was simply to add more cows, their solution might seem logical, but it was not ecological. Without reducing the contribution of conventional dairy farming to climate catastrophes, the industry helped promote more of the same (Khosrova, 2017). The entire agricultural world, not just dairy farms, plays a role in global warming through its vast fossil-fuel-fed transportation network, high-energy consumption, and use of chemical fertilizers and pesticides. But while livestock production accounted for just 4.2% of American greenhouse-effect gas emissions, its effect on climate change could be disproportionately higher: methane, produced by ruminants' belching, is more than 20 times more powerful than carbon dioxide at trapping heat in the atmosphere. So most efforts by the dairy industry at reducing greenhouse-effect gas emissions aim at methane. According to Michel Wattiaux, professor of dairy-systems management at the University of Wisconsin, there have been encouraging results in Europe and Canada in efforts to reduce cow's production of methane through nutrition, though the search for a long-term, cost-effective strategy has been elusive. M. Wattiaux's colleague Dan Schaefer explained that an experimental chemical additive in feed reduced methane emissions by 30% in test cows without any apparent harm to the animals or their milk production. In the United States, the dairy industry is "focused on breeding dairy cows that produce the same amount of milk, or more, using less feed," M. Wattiaux stated. This approach is not without controversy: intensive genetic selection to breed today's mega-yielding milk cows had reduced their fertility and made calving more difficult (Khosrova, 2017).

As the dairy world continues to work towards making production more environmentally friendly, butter lovers can do their part. Steffen Schneider, head of the Institute for Mindful Agriculture in the Hudson Valley, and a farmer who managed the biodynamic Hawthorne Valley Farm for more than 20 years, suggests that consumers choose dairy products from sustainable sources. Moreover, he added, fertilizing with composted manure from such cows instead of manufactured fertilizer "sequesters" carbon dioxide, removing it from the atmosphere. In choosing an "eco-healthier" butter, the cost will be higher than for a conventional brand. "But in the big picture of dairy desires versus climate care, a steady supply of butter in the future is liable to cost us one way or the other," concluded Elaine Khosrova (Khosrova, 2017). In her book, titled *Butter: A Rich History* (2016), Elaine Khosrova has travelled across three continents to stalk the modern story of butter. Award-winning food writer and former pastry chef, she serves up a story as rich, textured and culturally relevant as butter itself. From its humble agrarian origins to its present-day artisanal glory, E. Khosrova reminds us about the ancient butter bogs of Ireland, the pleasure dairies of France, and the sacred butter sculptures of Tibet. She also details butter's role in history, politics, economics, nutrition and even spirituality and art. The book by Elaine Khosrova also contains an essential collection of core butter recipes, as well as practical how-tos for making various types of butter at home – or shopping for the best.

Spread of Greek yogurt across America

Hamdi Ulukaya arrived in the United States in 1994 with US$ 3,000 in his pocket. He was an immigrant from Turkey – Chobani means "shepherd" in Turkish – hoping to learn English and find his way in a new country. Today, H. Ulukaya, 44 years old, is the owner of Chobani, a start-up reared on small business loans among crumbling barns in upstate New York. Chobani, the Greek yogurt maker he founded in 2007 had annual sales of *ca*. US$1.5 billion and H. Ulukaya owned most of the privately held company. He stated in an interview with David Gelles that his father said to him: "You should make cheese here. There is no good feta cheese here." And he replied: "Why would I do that? I did not come from 2,000 miles away to make exactly what we were making back home." Then it was two years of struggle and he thought he was going out of business every single day (Gelles, 2018). He saw an advertisement for a fully equipped yogurt plant for sale, asking for US$700,000. Kraft was closing it. By 17 August 2005, he had the key of the factory. When H. Ulukaya sold his first cups of Chobani, at a Long Island grocery store in 2007, Greek yogurt accounted for 2% of American yogurt sales. In 2017-2018, it was generating a quarter of all revenue in the US$7.6 billion yogurt industry. H. Ulukaya has expanded at warp speed, capturing half of the Greek yogurt market and beating giant companies like General Mills and Dannon (Steinmetz, 2012; Gelles, 2018).

Chobani's creation has nothing to do with Greek roots. The name simply tells consumers that it is strained yogurt, standard fare across Europe and Asia. The appeal of strained yogurt is its thicker texture, higher protein content and typically tangier taste that the sweetened yogurt common in American dairy aisles. In the United States, consumers can also count on its being about 99% more expensive than the non-Greek stuff. Chobani had a short list of ingredients: only milk and cultures of proprietary blends of bacteria that ferment the liquid into something spoonable and mouth puckering. Many Greek-yogurt brands like the Greece-based company Fage, which started sending its yogurt to American specialty stores over a decade ago – in the early 2000s – and accounted for 15% of the American market claimed similar characteristics. H. Ulukaya said Chobani's success comes down to his belief early on that the product could appeal to a broad range of customers, not just those shopping in speciality stores. Within its first three years on the market, Chobani trounced Fage by heading straight into deals with big grocery chains like Giant and ShopRite. A lower price point than that of other Greek yogurts and a larger container also appealed (Steinmetz, 2012).

Word-of-mouth buzz and social media rather than big advertising – the company had aired only a single advertisement campaign – have been a boon for the segment. At Chobani headquarters in New Berlin, New York State, H. Ulukaya stated that from 2007 to 2012 they went from a handful of people to hundreds. And the sales grew up to US$1 billion within that five years. There are now people from 19 different countries working at Chobani – 500 to 600 people (Gelles, 2018). Women who drive 63% of grocery sales, like that even expensive yogurt which seems cheap compared with other health foods. Greek yogurt's popularity among celebrity chefs has not hurt. "There really was a need for a nice, thick, rich, simple ingredient in a plain flavour," stated Susan Stockton, who oversees recipes at the Food Network. S. Stockton views

Greek yogurt's popularity as part of a larger trend: Americans expanding their palates, venturing away from sweets towards sours. She believed the versatility of Greek yogurt – which can substitute for sour cream and mayonnaise – will help guarantee its status as a staple (Steinmetz, 2012).

The Chobani-led boom has inspired other small creameries in New York State, where dairy farms abound. New York City consumers are close by and local governments are doling out incentives to promote the industry. Local producers have benefited from the presence of Chobani's and Fage's New York plants, since it takes much more milk to produce Greek yogurt than the regular foodstuff. About three hours from Chobani, a couple running a fourth-generation dairy farm is crafting its own whole-milk Greek yogurt with local flavour: maple syrup from a neighbour's farm. They had been making their Argyle cheese and farm products for more than five years. They targeted foodies at farmers' markets and farm-to-table restaurants that could pay higher prices for something rich and exotic. Lagging brands like Yoplait have also gone Greek to boost profits, and Dannon's Greek yogurt is gaining speed. So far, H. Ulukaya has stayed ahead; he invested US$250 million in a sprawling plant in Idaho to better access customers across the country. He believes that if the United States is still spending just one-third the amount Western Europe spends on yogurt, there is plenty of room to grow alongside other brands. "We believe that the yogurt story in this country has not even started yet" … "This is a product like bread and cheese … You must have it. You will always have it," he stated (Steinmetz, 2012).

Coffee with cream: a drinking habit of some Americans

The consumption of coffee with cream across America had become more than a drinking habit, but also a sociological and ideological indicator. At least, this what the phrase *latte liberal* means, because it literally designates those "progressists drinking coffee with cream." For the last 24 years, this idea has been present in the American public debate. This interest was triggered during the summer of 2018 by a publication of an article authored by two researchers of the University of Pennsylvania, and titled "The true reason why progressists drink coffee with cream" (Dujin, 2018). The phrase *latte liberal* is applied to upper classes of urbanites who, according to the conservatives – who often use this expression – associate their progressive ideology with a distinct way of life, that includes the frequent attendance of coffee shops. In the American imagination, the *latte liberal* has very good wages or income, uses the bicycle for his rides and shops in organic groceries. Generally white, he nevertheless cares about minorities, ethnic or gender ones. He also cares about the poor without knowing in depth their living conditions. And his favourite drink is an expresso with milk cream, costing *ca*. US$5 or €4.30. All these features tie him/her to a world that is different from that of the "middle-class American," who drinks his filtered coffee in a mug, the famous *cup of Joe* (Dujin, 2018).

The association of coffee with cream with upper classes who vote for the left goes back to the 1990s. This association has triggered a real academic and communication interest. Taking the expression from the American journalist Alan Ehrenhalt who used it for the first time, David Brooks, an editorialist of *The New York Times*, published

in 1997 in *The Weekly Standard*, an article on *latte towns* which had a great impact. These towns, often university ones, are those where the numbers of coffee shops and other sophisticated shops are increasing, but where it is more difficult to find products of wide consumption at a reasonable price. As they were rapidly associated with their populations, these *latte towns* meant in fact an increasing territorial segregation between gentrified districts and popular ones that lost their former industries. Later on, the phrase *latte liberal* testified of the rise in lifestyle as a political marker, and of a lesser interest in the mobilization around collective causes. Thus the *latte liberal* became the symbol in the American Left of a progressist value system associated with a participation in financial capitalism (Dujin, 2018).

However, there is a lack of empirical work that could help show that progressists drink more *latte* than the average people. But this has been achieved through this new publication which effectively shows more consumption of *coffee latte* (coffee with cream) among the Democrats. Associated with the level of income and the residential environment, with more or less coffee shops, the consumption of *latte* would be explained by the degree of opening to, and tolerance of, globalization. The foreign name (Italian) of the beverage and its European origins would attract more of the people that seek the opening to the world, whereas conventional filtered coffee is the favourite beverage of the more conservatives. This may be strange for a European because the *latte*, especially when it is served in large paper cups, seems to be a typical American product. What is ironic is that the giant Starbucks opened its first shop in Italy on 5 September 2018, just a few months after the 5-Star Movement came to power. Anne Dujin (2018) asked therefore the question: "Would the Italian Left find thanks to the consumption of this beverage a good reason to open itself to the rest of the world"?

SEAFOOD

Triploid oysters on the seafood platter

In 1999, triploid oysters – the result of biotechnological research and containing in their cells three sets of chromosomes – were found in French hatcheries and oyster farming. At that time, the company Grainocéan, led by Eric Marissal, devoted its activity to farm this bivalve, especially in its hatchery of La Rochelle (centrewest of France). The advantages of this mollusk are that it is sterile, and therefore more fleshy and without milk during the summer; it was rapidly and enthusiastically adopted by the oyster farmers. The shellfish can be packaged easily, because they can be well calibrated and separated from each other. However, the adoption of these triploid oysters raised controversies, because part of the farmers suspected them of having made their regular oysters more susceptible to two pathogens: the ostreid herpesvirus 1 and thereafter the bacterium *Vibrio aertunasus*, which have wrecked havoc upon the farms since 2008 (Valo, 2015). In Grainocéan's facilities, 2 billion triploids are annually produced. Every day, 45,000 litres of plancton, cultivated on the site, are needed for feeding the spat. The largest hatchery of France also includes three nurseries with an acreage of several tens of hectares on the *Ile de Ré* (Ré Island, centrewest of French Atlantic seashore); the mollusks grow in these nurseries or hatcheries before being transferred to the open sea. Their growth will continue there in bags containing 60,000 oysters each and hooked on 4- to 5-km-long rails. Once they have reached the size of 1 mm to 4 mm, after three or four months, about half of these oysters are sold to farmers who let them grow for an average of two years, compared with three years for the wild sea-harvested oysters (Valo, 2015).

How triploid oysters are developed? At the time of laying, female diploid oysters – i.e. natural oysters having two sets of chromosomes in their cells – are fertilized by a male which produces several hundreds of millions of gametes, whereas each female produces 40 to 50 millions eggs in about one hour. But in the case of Grainocéan, this male is tetraploid – four sets of chromosomes in the cells – and it has been developed in the laboratories of the French Research Institute for the Exploitation of the Sea (IFREMER, French acronym for *Institut français de recherche pour l'exploitation de la mer*). Every year, the IFREMER experimental station located in La Tremblade (department of Charente-Maritime, centrewest of the French Atlantic seashore) supplies 100 to 200 tetraploid males to the commercial hatcheries. While the male oysters reach their maturity during the summer, those supplied by IFREMER can reproduce from February to September. When Grainocéan receives five of these male oysters at the end of August, the muscle which supports the superior valve of the oyster is cut off

so that their life expectancy is rather short. For those who are sent through the French mail service, they bear an electronic chip that permits their traceability; and they must be sent back to IFREMER experimental station in La Tremblade so as to avoid their dissemination in the environment where they may produce sterile spat. Biotechnology is the tool for producing those tetraploid male oysters: "When the diploid female produces its gametes, the scientists inhibit the expulsion of polar globules using a chemical treatment, and that gives rise to a tetraploid," explained Sylvie Lapègue, in charge of the mollusk genetics, health and microbiology unit at La Tremblade. The triploid offspring is not a genetically modified organism (GMO) according to the European regulation, because there is no genetic engineering (Valo, 2015).

IFREMER who was relying on an American process – protected by the Rutgers 2014 patent – is now using its own process the patent of which was requested in 2008. Each tetraploid male genitor was billed for at least €1,000 to the hatcheries – 3% of their annual turnover. "That is a strategic approach, because IFREMER's objective is to focus on upstream research and not to pursue a routine production which requires a team of several scientists, engineers and technicians, and which needs quite a lot of space," explained Sylvie Lapègue. It has been estimated that 60% of oyster farmers breed both kinds of oysters: they produce more oysters from hatcheries during the years when the harvest of spat is poor, and conversely. What is exactly the proportion of triploid oysters on the market? "Maybe 30%," replied carefully Gérald Viaud, president of the National Shellfish Committee. The French government has reacted to the criticisms regarding the role of IFREMER in the wider use of triploids, which are present in all breeding ponds. In fact, the association *Ostréiculteur traditionnel* (Traditional Oyster Breeder) requested a mandatory labeling that would help distinguish their oysters from those produced by the hatcheries (Valo, 2015).

Shrimps and prawns: how to meet a growing demand?

In the United States, shrimp overtook canned tuna fish as the most consumed seafood per capita in 2002. Americans consumed an average of 3.8 pound of shrimp (per capita and per year) in 2012, twice the amount three decades ago, according the National Oceanic and Atmosphere Administration. But the country's taste for shrimp has heavy social and environmental costs. Most of the shrimps imported by the United States come from farms in Latin America and in Southeast Asia, where environmental and human-rights experts have long identified labour-rights abuses, hazardous working conditions, damage to ecosystems as well as the use of hormones and antibiotics. In 2013, a bacterial disease has hit shrimp farms across Asia and Mexico, crippling production (Tabuchi, 2014).

In terms of shrimp fishing, the stocks are under pressure across the globe. China, once a major exporter, now imports shrimp to meet a growing demand. American regulators called off 2014's Gulf of Maine shrimping season after research suggested that overfishing and warming waters had driven stocks to new lows. These mounting concerns are spurring a new generation of shrimp farmers, like James Tran's Sky8 Shrimp farm, located South of Boston, Massachusetts, who are developing ways to reduce their environmental footprint. The number of small indoor shrimp farms in

the United States has grown from just two to at least 22 from 2009 to 2014, with dozens more in the pipeline. "The situation is very much in flux," stated Pete Bridson, aquaculture research manager at the Monterey Bay Aquarium's influential Seafood Watch programme, which gives shrimps from these tank-based farms its highest rating for seafood that is farmed or fished sustainably. "We are seeing newer farms come along that engage in closed, intensive shrimp farming, and there is certainly a market for that," he added (Tabuchi, 2014).

The new wave in American shrimp farming is part of a push by both government and industry officials to raise the status of aquaculture and reverse a disdainful public perception of farmed seafood that stems in part from past controversies over cultivated seafood. Overall, American farmers made up more than 1% of global aquaculture production in the early 2000s, according to FAO. Fisheries officials estimated that doubling (or more) American aquaculture production could create 50,000 jobs at least and more than US$1 billion in revenue for farmers. At Sky8 Shrimp farm, run by four workers, it takes about three months to grow batches of 40,000 shrimp larvae, which feed on fish meal, algae and seaweed, to a size favoured by retailers and restaurants. Sky8 Shrimp farm has been developing a feed that is free of fish meal. The farm uses tanks of Atlantic Ocean water, filtered and reused from harvest to harvest. There are no antibiotics, no hormones and no pesticides, according to tests carried out by the Food and Drug Administration (USFDA), which regulates the safety of shrimp production. There is also little risk that shrimp might escape and harm wild stocks. All this attention to detail comes with a cost: James Tran's Sky8 shrimp farm ships as much as 1,300 pounds of fresh shrimp a month to local high-end buyers at US$15 a pound, as much as twice the price imported frozen shrimp can sell for (by the mid-2010s). Still the farm is struggling to meet the demand from local retailers and restaurants (Tabuchi, 2014).

The United States' attempt to boost commercial shrimp farming dates to the early 1970s, but they struggled to compete with cheap imports. And early shrimp farms were in open-air ponds or near the coast, and sometimes released effluents into vulnerable ocean habitats. But by the mid-2010s, the tide may be turning. The average price of shrimp imported into the United States was 45% higher than earlier and that enables the local shrimp industry to better compete. Experts also say consumers are increasingly demanding more sustainability and food transparency – though American shrimp farmers could still struggle to convince the average shopper that seeking out homegrown shrimp at higher prices is worth the deal (Tabuchi, 2014).

Insect feed for aquaculture

An example of sustainability in aquaculture is to seek for a sustainable supply of feed for the growth of shrimps and prawns. In Malaysia, two French entrepreneurs have set up a facility that produces the black-soldier fly (*Hermetia illucens*), which is the basic feed of shrimps and prawns. Frederic Viala is a businessman and navigator across the Indian Ocean, while Franck Ducharne is a biologist and veterinarian who started in the breeding of silkworms and then moved to shrimp farming in Guatemala, Madagascar and finally in Thailand. Both of them were *ca*. 50 years old when they decided to create an experimental farm in Malaysia with a view to testing the potential of insect-

protein production and its use in aquaculture. The logics of this kind of process is rather simple: 10 kg of plant proteins are necessary to produce 1 kg of beef proteins or 6 kg of fish proteins, whereas the same quantity of plant proteins can produce 10 kg of insect proteins. We have seen earlier the attempts to produce and use insect protein for human food consumption, as well as the problems of its social acceptance. In the Malaysian case, the insect proteins are used to feed shrimps and prawns, eaten afterwards by humans (Philip, 2015).

It has been estimated that 70% of arable lands are used to raise domestic animals and it cannot be possible to continue to destroy forests and woodlands in order to transform them into grazing lands or to produce all kinds of feed for bovine, pig, poultry livestock and fish. According to FAO, the research on large-scale farming of insects for food and feed is a top priority. Six countries – United States, Argentina, Brazil, China, India and Paraguay – produce 95% of the world's soybeans – a major source of feed for livestock. Ten other countries including Peru, China, Thailand, etc., produce 65% of fish meal, also an important source of feed, particularly in aquaculture. Therefore the boom of aquaculture across the world supports the views of those who are in favour of the industrialization of insect-flour production: one fish consumed out of two comes from farming and Asia alone supplies almost 90% of the global aquacultural production (Philip, 2015).

The experimental farm mentioned above is located at Sri Kundane, a village in the Selangor State, near Kuala Lumpur, Malaysia's capital. The project was christened "Entofood" and it is based on the multiplication of *Hermetia illucens*, using a solid culture medium made from the transformation of domestic garbage; the latter is collected from the town's restaurants and is screened, and thereafter transformed into a mashed paste. The overall objective of the whole process is to have a zero impact on the environment and in particular to recycle any effluent coming from the smashing of the garbage and wastes. The second stage of the process takes place in an aerated greenhouse where the fly larvae, placed in batches, feed on the humid broth resulting from the initial paste. The next stage concerns the development of the larvae into adult black-soldier flies which lay eggs in order to pursue the reproductive cycle. The last stage is to cook the larvae and to press their bodies, with the subsequent excretion of oil. The dried and fat-free larvae are ground and give a very rich protein flour. At Sri Kundane, the production target of insect protein-based feed has been at least 3 tons of feed per day. The demand for insect feed seems to be growing, due to the rising price of fish meal, which jumped from €700 a ton in 2005 to €2,000 in 2015. Both French entrepreneurs stated that in addition to producing more insect feed, the price of the latter will become competitive due to cutting off production costs (Philip, 2015). See also p. 240.

A growing consumption of seafood and fish: the case of the United States

In 1982, a Chinese aquaculture scientist named Fusui Zhang journeyed to Martha's Vineyard in search of scallops. After a visit to Lagoon Pool in Tisbury, he boxed up 120 scallops and took them away to his laboratory in Qingdao. During the journey, 94 died, but 26 thrived. Thanks to them, today China grows millions of dollars worth of

New-England bay scallops, a significant portion of which is exported back to the United States. According to the National Marine Fisheries Service, even though the United States controls more ocean than any other country, 86% of the seafood Americans consume is imported. The most blatant seafood swap has been the abandonment of local American oysters for imported Asian shrimp. Most American Atlantic estuaries had vast reefs of wild oysters. Many of them were destroyed through overharvesting. But because oysters are so easy to cultivate, a primitive form of oyster aquaculture arose up and down the Atlantic coast. Until the 1920s, the United States produced two billion pounds of oysters a year. But due to the urban sprawl and the flow of sewage, as well as to industrial dumps, the Atlantic oyster aquaculture fell to just 1% of its historical capacity by 1970 (Greenberg, 2014).

The shrimp cocktail rose to replace the oyster appetizer, thanks to a Japanese scientist named Motosaku Fujinaga and the *kuruma* prawn. *Kuruma* prawns were favoured in a preparation known as "dancing shrimp", a dish that involved the consumption of a wiggling wild shrimp dipped in sake. M. Fujinaga figured out how to domesticate this pricey crustacean. His graduate students travelled across Asia and tamed other varieties of shrimp. Nowadays, shrimp, mostly farmed in Asia, is the most consumed seafood in the United States: Americans eat nearly as much of it as the next two most popular seafoods – canned tuna and salmon – combined. The amount of shrimp consumed nowadays is equivalent to the per capita oyster consumption a century ago. By the beginning of the 1990s, two new white fish started to be imported from Asia into the United States: tilapia which grows very fast and the Vietnamese *Pangasius* catfish which grows even faster. These two are America's fourth- and sixth-most-consumed seafoods, respectively. Alongside them arose an indigenous wild American Pacific fish called the Alaskan, or walleye, pollock. In just a few decades, pollock fishing went from negligible to billions of pounds a year. Pollock is now the fish in McDonald's Filet-o-Fish. Every year, more than 600 million pounds are frozen into giant blocks and sent to the churning fish processing plants of Asia, Germany and the Netherlands (Greenberg, 2014).

Wild Atlantic salmon caught off Nova Scotia, Canada, or elsewhere in the North Atlantic used to be called "nova lox", but most wild Atlantic salmon populations have been fished to commercial extinction, and nowadays a majority of the lox consumed in the United States comes from selectively bred farmed salmon, with Chile as the largest supplier. This may seem curious, given that salmons are not native to the Southern Hemisphere. But after Norwegian aquaculture companies took them there in the 1980s, they became so numerous as to be considered an invasive species. The prevalence of imported farmed salmon in the United States is doubly curious because the country possesses all the wild salmon it could possibly need. Five species of Pacific salmon return to Alaskan rivers every year, generating several hundred million pounds of fish flesh annually. Where does it all go? Increasingly to Asia. Alaska, by far the biggest fish-producing State, exports *ca.* three-quarters of its salmon. But strangely enough, a portion of that salmon, after heading across the Pacific, returns to the United States: because of cheap foreign labour, many Alaskan salmons are caught in American waters, frozen, defrosted in Asia, filleted and deboned, refrozen and sent back to the United States. In other words, in terms of international fish trade,

exports "may include merchandise of both domestic and foreign origin," explained the National Oceanic and Atmospheric Administration. So when fish sticks are cut from blocks of imported "white fish" in an American facility and exported, they are classified as American domestic production. Meanwhile, some of the imports are taken from American waters, reprocessed elsewhere and brought back home. By the mid-2010s, the leading countries for salmon imports to, and exports from, the United States, were: China, which imported *ca*. 42,000 tons and exported *ca*. 96,000 tons; and Canada, which imported *ca*. 87,000 tons and exported *ca*. 51,000 tons. The main countries that exported salmon to the United States were Chile (*ca*. 127,000 tons), Norway (*ca*. 22,000 tons) and the Faroe Islands (*ca*. 18,000 tons). The United States was exporting *ca*. 18,000 tons of salmon to Thailand, *ca*. 18,000 tons of salmon to the United Kingdom and *ca*. 17,000 tons to South Korea (Greenberg, 2014).

Dwindling stocks of cod

New England has long been synonymous with cod fishing. Since the 1600s, cod has been central to the region's development, even giving Massachusetts' famous cape its name. The fishery resources of the Western Atlantic once seemed virtually limitless. And yet the current emergency efforts to restore cod populations is simply the latest chapter in a 150-year saga in which fishermen, scientists, industrialists and politicians have consistently confronted emptier nets and fewer fish. As early as the 1850s, fishermen from Maine and Massachusetts began to request their governments to do something about declining cod catches. Those men fished with hooks and lines from small wooden sailboats and rowboats. Fearing "the material injury of the cod fishing interests of this State," by increased fishing for menhaden, a critical forage fish for cod, fishermen from Gouldsboro, Maine, implored the Legislature in 1857 to limit menhaden hauls. Yet annual cod landings in the Gulf of Maine continued to slide, from *ca*. 70,000 tons in 1861 to *ca*. 54,000 tons in 1880 and to *ca*. 20,000 tons in 1920s, and just a few thousand tons in recent years. There have been a few upsticks along the way, such as one bumper year in the mid-1980s when the cod catch reached 25,000 tons – due, in part, to an unnecessarily large expansion of the fishing fleet –, but for the most part the trend has been noticeably downward since the era of the Civil War (Bolster, 2015; Brogan, 2015).

Maine's fishery commissioner, Edwin W. Gould, spoke out plainly in 1892. "It is the same old story. The buffalo is gone; the whale is disappearing, the seal fish is threatened with destruction." For E.W. Gould the path forward was clear: "Fish need protection." On 26 July 1914, after more than 40 years of reports on declining fishery resources by the United States Fish Commission and State fish commissions, *The New York Times* ran an article by Robert A. Widenmann forecasting disaster: "Extermination Threatens American Sea Fishes – cost to consumer has risen between 10 and 600 per cent because of decrease in supply." But that was right before a technological revolution in the fisheries. Sails and oars and hooks and lines were about to be replaced by steam and diesel engines, and massive nets dragged along the bottom of the sea that snared every fish in their path. Twentieth-century cod populations declined further. In 1954, a fisheries economist from Boston charged fishing interests with continuing "to exploit recklessly the limited self-renewing stocks of these species." That was just before the

first factory-equipped freezer-trawler arrived at the prime fishing waters around the Grand Banks off Newfoundland from Europe. The size of an ocean liner, it could scoop up everything in its wake. Those ships made the steam-powered draggers from 1914 look quaint. Overfishing has been the norm for a very long time, but the market has masked the mess in two ways. At every step, fishermen confronting declining catches developed gear that fished more intensively, taking a larger percentage of the fewer fish that remained. Such a strategy was clearly not sustainable. Meanwhile fishermen continued to earn enough to make fishing worthwhile, even if many encouraged their sons to pursue other careers because there would be little future in fishing. The Gulf of Maine cod stocks today are probably only a fraction of 1% of what they were during George Washington's presidency (Bolster, 2015).

In November 2014, regulators from the National Oceanographic and Atmospheric Administration shut down recreational and commercial fishing in the Gulf of Maine, that arm of the sea stretching east-northeast from Cape Cod. They did not have much choice: Federal law requires action to rebuild fish stocks when they are depleted (Bolster, 2015). In the Gulf of Maine and Georges Bank, estimates in 2015 placed cod at only 3% and 7% of their target levels, respectively. And even those targets were much lower than the populations' former abundance. However, two new proposals by the New England Fishery Management Council, a government body responsible for the fisheries in the region, threatened to undo years of work to protect Atlantic cod and other New-England fish species. First, the council proposed to drastically reduce the amount of protected habitat in New England waters, including by nearly 80% around the Georges Bank. The plan would allow for expansion of bottom trawling and dredging, two of the most destructive fishing methods, into protected habitats. In addition, the council wanted to suspend a programme that places observers on fishing vessels to monitor compliance. Thankfully, the Department of Commerce and the National Marine Fisheries Service had the final say about changes in protection and observer coverage. In particular, the latter had repeatedly stressed that any changes to habitat conservation must show that they will improve rather than degrade habitat conservation. This was considered a high bar that the council proposal will have hard time overcoming (Brogan, 2015).

The Ocean Prosperity Roadmap, a set of studies by a consortium of academic and non-profit researchers, demonstrated that responsible management practices, including habitat protection, quotas and catch monitoring would have not only lasting environmental benefit but also clear economic advantages. The authors of the studies analyzed thousands of fisheries across the world and found that the benefits of sustainable policies outweighed the costs by an average ratio of 10 to 1 (Brogan, 2015). More, therefore, has to be done to protect the habitats of the Atlantic cod, so as to have a sustainable development of the stocks of this fish species, highly appreciated by the North Americans and the Europeans. There are many recipes for cooking cod and also conserving it in salted and dehydrated form, for preserving it and using it at the right moment. In addition to cod fishing, Atlantic scallops are one of the most lucrative parts of the American fishing industry, responsible for hundreds of millions dollars-worth of selling the shellfish every year. Scallop companies have a well-funded industry group, paradoxically named the Fisheries Survival Fund, which spends more

than a quarter of a million dollars a year advocating for their interests, often at the expense of other fisheries. Dissatisfied with its current profits, the scallop industry has been pushing towards reopening portions of the most important New England cod habitat on Georges Bank, where the bottom-scraping scallop dredges would destroy any hope of rebuilding cod populations (Brogan, 2015).

Combating illegal fishing

The Pew Charitable Trusts, an American research group, reckoned that around one fish out of five sold in restaurants or shops, has been caught outside the law. That may amount to 20 million tons of them every year worth more than US$ 23 billion. This illegal trade, though not the only cause of overfishing, is an important one. Stamping it out would help those countries whose resources are being stolen. It would also help to conserve fish stocks, some of which are already threatened with extinction. A new monitoring system has been developed by the Satellite Applications Catapult, a British government-backed innovation centre based at Harwell, near Oxford, in collaboration with Pew. To sum up, it is a big data project, pulling together and crosschecking information on tens of thousands of fishing boats operating around the world. At its heart is what its developers call a virtual watchroom, which resembles the control centre for a space mission. A giant video wall displays a map of the world, showing clusters of lighted dots, each representing a fish boat. The data used to draw this map come from various sources, the most important of which are ships' automatic identification system (AIS). They broadcast a vessel's identity, position and other information to nearby ships and coastal stations, and also to satellites. An AIS is mandatory for all commercial vessels, fishing boats included. Such boats are also required, in many cases, to carry a second device, known as Vessel Monitoring System (VMS). This transmits similar data directly to the authorities who control the waters in which the vessel is fishing, and carrying it is a condition of boat's license to fish there. Enforcement of the AIS regime is patchy, and captains do sometimes have what they feel is a legitimate reason for turning it off, in order not to alert other boats in the area to profitable shoals. But the VMS transmits only to officialdom, so there can be no excuse for disabling it. Switching off either system will alert the watch room to potential shenanigans (*The Economist*, 2015a).

The watch room first filters vessels it believes are fishing from others that are not. It does it by looking at, for instance, which boats are in areas where fish congregate. It then tracks these boats using a series of algorithms that trigger an alert if, say, a vessel enters a marine conservation area and slows to fishing speed, or goes "dark" by turning off its identification systems. Operators can then zoom in on the vessel and request further information to find out what is going on. Satellites armed with synthetic-aperture radar can detect a vessel's position regardless of weather conditions. This means that even if a ship has gone dark, its fishing pattern can be logged. Zigzagging, for instance, suggests it is long-lining for tuna. When the weather is set fair, this radar information can be supplemented by high-resolution satellite photographs. Such images mean, for instance, that what purports to be a merchant ship can be fingered as a transshipment vessel by watching fishing boats transfer their illicit catch to it (*The Economist*, 2015a).

Enforcing the use of an identification number that stays with a ship throughout its life, even if it changes hands or country of registration, is also necessary. An exemption for fishing boats ended in 2013, but the numbering is still not universally applied. Signatories to a treaty agreed in 2009 to make ports exert stricter controls on foreign-flagged fishing vessels, also need to act. Fishermen seek out ports with lax regulations to land illegal catches. One of the most promising ideas for using the watch room is that shops could employ its findings to protect their supply chains. The watch room's developers have been already in discussion with a large European supermarket group to do just this. The watch room will also allow the effective monitoring of marine reserves around small island states that do not have the resources to do it for themselves. The first test of this approach could be to regulate a reserve of 836,000 km^2 around the Pitcairn Islands group, a British territory in the middle of the South Pacific with only a few dozen inhabitants. The Pitcairn reserve, which was set up by the end of 2015, will be one of the world's largest marine sanctuaries. By proving that the watch room can keep an eye on such a remote site, its developers hoped other places with similar requirements will be encouraged to be involved. The watch room system is, moreover, capable of enlargement as new information sources are developed. One such may be nanosats. These are satellites, a few centimetres across, that can be launched in swarms to increase the number of electronic eyes in the sky while simultaneously reducing costs. Closer to the surface, unmanned drones can do the same. The watch room, then, is a work in progress. But in the global endeavour to enforcing fishing regulations, the watch room system will provide an important advantage to effectively do that (*The Economist*, 2015a).

Caviar: Italy, a global competitor

Italy has become the world's second-biggest producer of caviar, just behind China, but ahead of Russia and Iran, which used to be the former leading producers of this seafood delicacy. In the heart of Italy is the Po Valley; in Lombardia, two hundred kilometres from the seashore, sturgeons are raised by the Agroittica company, not very far from a steel-mill. Italy has thus tried to compete in caviar production, after the total prohibition of fishing wild sturgeons – a species threatened with extinction. The only practical solution left is fish farming. It was not a complete surprise to sea sturgeons being raised. In 1550, the famous Renaissance painter, Le Tintoret, painted the sturgeon on a canvas called Animal Creation. Also in 1471, the Italian gourmet Bartolomeo Sacchi mentioned caviar in his book, *De honesta voluptate et valetudine*, the first best-seller printed recipe book for the Renaissance upper classes. Up to the 1950s, sturgeons were found in the waters of the Po and Tiber rivers, as well as in the Arno river flowing through Florence and even in the Gulf of Palermo. According to Mario Pazzaglia, in charge of scientific projects and external relations of Agroittica, "only the wealthy people could taste this delicacy. Regarding the fishermen, it was like finding a safe box and it was out of the question to also taste it. This product, in fact, was never adopted by the people." However, due to overfishing and the worsening of water quality, sturgeon would have disappeared from the Italian territory if in 1978 a visionary man from Lombardia and a Russian biologist did meet and find the right solution. At that time, Gino Ravagnan was the manager of a steel-mill and he was

using the large volumes of water and heat resulting from steel production, to raise eels in ponds. But G. Ravagnan was in fact dreaming of raising sturgeons. He received some very young fish from Serge Doroshov, a Russian professor working in California on the white sturgeons thriving in the Sacramento river. The Italian farm which was launched after this successful beginning, had by the end of 2018, 350,000 sturgeons and it produces a caviar brand, called Calvisius; in 2017, the production reached 28 tons of caviar that were sold across the whole of Europe, but also in the United States and even in Russia (Nasi, 2018b).

Sturgeons have appeared 250 million years ago. They have a life expectancy of 100 years and they can become sexually mature rather late: for instance, the beluga species (*Huso huso*), which gives a very coveted caviar, needs *ca*. 20 years before its precious eggs can be collected. This explains, to a large extent, the high market prices of caviar: in 2018, between €50 and €179 for a box weighing 30 g of caviar – the price range depends on the farmed sturgeon species. It is commonly thought that caviar should be tasted with vodka. But this habit was adopted when the cold chain did not exist: the product was therefore badly preserved and an alcoholic beverage could hide a too strong savour and flavour. But nowadays, fresh caviar, taken from its refrigerated case, can be matched with champagne very well (Nasi, 2018b). It is worth mentioning that vodka – literally meaning "tiny water"in Russian – has been manufactured since the 15th century. In 1894, the patent for Russian vodka – a distillate with an alcohol degree of 40° Gay-Lussac, filtered on charcoal – has been filed by the Russian government. The choice of the fermented raw material – rye, wheat, potatoes –, the number of distillations and of filtrations give the variety of flavours and savours of this beverage. It is generally recommended to drink it straight, cool but not iced, and with salted snacks or meals.

PART THREE

BEVERAGES

CONTENTS

TEA

Kenya: a global player

Since the British have introduced its cultivation at the beginning of the 20th century, green tea has become the "green gold" of Kenya. The country has become the world's biggest exporter of tea, and its selling centre, located in Mombasa, on the Indian Ocean coast, is the heart of the global commercialization of this aromatic species. In 2016, Kenya had exported 480,000 tons of tea, far ahead of its Indian, Chinese, or Ceylanese competitors. Tea makes up one-quarter of the exports of the country, they fetched €1.4 billion in 2018, six times more than coffee – €176 million. In 1964, when Kenya became independent, the Kenyan Tea Development Agency (KTDA) has been created. In 2017-2018, it was running 67 tea factories which produced 60% of the Kenyan tea. The KTDA is managed like a cooperative: the agency's shares are held by 600,000 small tea growers, who collectively possess the company. The KTDA helps the smallholders at each stage of their work: technical assistance, management of the factories, transport, supply of fertilizers and energy, financing and microcredit. For instance, at Kangaita, on the southern slopes of Mount Kenya, at an altitude of 2,000 m, the factory transforms up to 100,000 kg of tea leaves per day. Trucks daily deliver the harvest of the region's 6,000 farmers to the plant. In one of the biggest tea factories of the country, the daily deliveries are inspected, weighted and controlled, before being emptied from inside, using big machinery. Tea leaves are wilted, torn in pieces and dried, before being packed and given a specific number. "Tea must be dried in the ovens for 27 minutes precisely and at a temperature of 95-98°C. Otherwise, it is a total failure," stated Eric Kimathi, a manager of the Kangaita factory (Meyerfield, 2017).

According to Julien Lefilleur, in charge of industry and services at Proparco, a subsidiary of the French Development Agency (AFD, French acronym for *Agence française de développement*), which has made several loans to the KTDA, "in general, agricultural cooperatives are poorly managed in Africa, with bad examples in cocoa and palm oil commodities in West Africa;" but he stated that in Kenya where corruption is still embedded in the economy, "tea is a sector apart, extremely privileged; there is little political interference and the KTDA directorate is autonomous. In terms of governance, the KTDA is rigorous with competent and reliable managers" (Meyerfield, 2017). In 2017, an exceptional drought hit the country, including the humid and fertile areas of Central Kenya. Tea production was therefore expected to decrease by 11% – a catastrophy for the hundreds of thousands of tea growers and for the country's balance of trade. The sector also suffered from structural problems, explained in a report published at the end of June 2017 by the Kenya Institute for Public Policy Research and

Analysis (KIPPRA) in partnership with the African Capacity Building Foundation (ACBF, *Fondation pour le renforcement des capacities en Afrique*).

This report analyzes the institutional and human capacities of the tea value chain in Kenya. There is indeed a need to initiate transformative actions aimed at enhancing the subsector's productivity and contribution to national economic growth and development. The transformative agenda is also aimed at strengthening agribusiness trade and international competitiveness as designed in the Kenya Vision 2030. In 2016, tea accounted for 40% of the marketed agricultural production and contributed 25% of total export earnings amounting to US$1.25 billion. In addition, tea provides livelihoods to *ca*. 600,000 smallholders who contribute approximately 60% of total tea production. However, only 14% of tea exported is value added and the remaining is sold in bulk form. The low level of value addition results in an estimated loss of US$12 per kg of tea. As a result despite Kenya being the leading exporter in terms of volumes, the country receives low earnings compared with other exporting countries due to low value addition. For instance, in 2013, Kenya exported 131 tons more than Sri Lanka but earned US$0.3 billion less (KIPPRA, 2017).

The study indentified key issues at the production level: high labour cost, which accounts for 68% of the production cost and widening yield gap between smallholder farmers and estates due to continued use of moribund tea bushes and the type of tea clone grown. Processing is characterized by concentration of black CTC (cut, tear and curl) tea as most factories have only a single production line, thereby limiting product diversification. In addition, processing has a high cost of energy and heavily relies on wood fuel. On the other hand, the main concerns in tea marketing include low domestic consumption, dominance of few multinational companies in the Mombasa Tea Auction which determine the prices, limited number of export destinations and shrinking of current markets. In addition, Kenyan tea is not branded and there is limited marketing research. At the institutional level, the key constraints are the delay in adoption of national agricultural policy and absence of a tea policy to guide the sustainable development of the sub-sector (KIPPRA, 2017).

There is a disconnect in the interpretations of the county government devolved roles and functions and those of the tea directorate with respect to tea. The county governments do not have a clear understanding of their role in the development of the tea sub-sector. Regarding human capacities, the study findings indicate gaps in the overall policy, legal and regulatory frameworks; staffing levels, and expertise in different aspects of the tea value chain, and lack of predictable and adequate financial mechanisms to enable institutions discharge their mandates. The report makes several recommendations required to effectively transforming the tea sub-sector. First, there is a need to promote mechanization for plucking and pruning, and at the same time offer basic training on machine operations. There is also a need to support smallholders to replace moribund tea bushes with higher-yielding tea clones while at the same time promoting complementary enterprises. Second, for the Kenya Tea development Agency (KTDA) managed factories, there is a need to expand their capacity to enable production of other teas than black CTC (specialty teas and extracts). To support the product diversification, investments will be necessary in human skill development and

production lines for manufacturing. In addition, factories should adopt innovations for reducing energy cost by shifting to energy-efficient technologies. Third, promote domestic consumption of tea by developing skill to redesign the marketing approach focusing on awareness campaigns and advocacy (KIPPRA, 2017).

For the export market, there is a need to diversify the market destinations especially in high tea-consuming market in Africa, like in Morocco and Nigeria. This can be achieved through bilateral trade agreements as well as other trading blocks. In addition, investing in market research especially market behaviour will be critical to consolidate existing markets and explore new ones. Other measures include promoting tea processing and branding within the Special Economic Zone (East Africa Tea Trade Association, EATTA) so as to enjoy the associated incentives and make Kenyan tea more competitive. Furthermore, there is a need for fast track adoption of the agriculture policy and the national tea policy, and for the separation of the governance of tea from other crops as it is the case in some countries. Thus, Tea Directorate ought to be managed outside the Agriculture Food Authority (AFA) Act while the Tea Research Institute (TRI) should be governed outside the Kenya Agricultural and Livestock Research Organization (KALRO). The AFA-Tea Directorate needs to set up a one-stop-shop that will provide information on the licenses, taxes and levies in the tea industry as well as the incentives and opportunities. This will be achieved by providing adequate human and financial resources, in addition to developing their skills. Tea research is largely focused on production and processing as opposed to market aspects. It is important to establish linkages between the sub-sector and the higher institutions of learning. Lastly, the county governments should be supported to develop appropriate strategies for the development of the tea sub-sector. In addition, the capacity of the county should be enhanced in terms of qualified staff, while departments should be provided with adequate funding to support the industry (KIPPRA, 2017).

Kenyan tea export market destinations are few. The country exports an estimated 84% of its tea to eight countries, of which half of these exports go to two countries namely: Pakistan and Egypt. The remaining 16% of the exports go to 67 other destinations. New market destinations for Kenya's tea include the United Arab Emirates (UAE), West and Central Africa and Russia. The UAE are ranked among the eight Kenya tea export destinations due to the opening of a warehouse in Dubai by the Kenya Export Promotion Council and Chai Trading Limited. The warehouse based at the Dubai Tea Trade Centre deals with the purchase, blending and packing of tea from Kenya. Kenya's world market share has consistently increased from 6% in the 1970s to 26% in 2014, but the domestic consumption has remained constant at *ca*. 5%. The narrow export base enhances vulnerability of Kenyan tea exports to external shocks. For instance, the drop in tea earnings in Kenya in 2013 was attributed to the political instability in key markets such as Egypt and Sudan (KIPPRA, 2017).

Furthermore, there is not yet a quality-brand image of "Kenyan tea", as it is, for instance, the case of "Ethiopian coffee". Black tea, known as CTC (cut, tear and curl), cheap and with a lower quality and a lesser delicate taste, makes the major part of the country's exports. According to the KIPPRA report, an improvement of the quality and a better promotion of the product would easily earn the country an additional annual revenue

of €85 million to €170 million. It seems that an increasing awareness of the situation is taking place: the KTDA entices all its growers and factories to move towards the production of higher-quality teas – with a more subtle taste, such as green, white and even purple teas. These higher added-value brands, which are being tested at Kangaita, would make up 5% of total production in the short term. This kind of message did not go unnoticed: the company Gold Crown, located in Mombasa, that employs more than 900 people, commercializes the Kericho Gold tea brand. It is present in all Kenyan supermarkets and offers a whole range of quality teas and infusions with several flavours – mint, passion fruit or even vanilla and chocolate. "Our target is the African middle class that is growing rapidly. This generation is more demanding and bolder, it wants more mixtures and new flavours," stated Fahim Ahmed, Gold Crown's executive officer. He added that Gold Crown sells only 2,000 tons of tea annually in Kenya – 6% of the local market. There were therefore good prospects for improvement in the short and medium terms (Meyerfield, 2017).

Land grievances and their impact on tea plantations

At independence in 1963 the departing British set aside money to buy back land in the "White Highlands", which had been reserved for settlers, and redistribute it among land-hungry Africans. Though many benefited, much of the land went to those with political connections. The family of Kenya's first president, Jomo Kenyatta, was among the biggest winners. The politicians, however, were happy to let foreign companies own big tea and coffee plantations, so long as they had a share of the profits. The colonists had turned tea and coffee into mainstays of the economy. In 2010, Kenya adopted a devolved constitution that hands hefty powers to 47 newly created counties. It also created a National Land Commission with a mandate to address "historical land injustices and recommend appropriate redress." In addition, it lopped a nine off the 99-year leases granted to foreign owners of big farms in the former White Highlands. But it failed to specify when the 99 years started, allowing some governors to make the dubious claim that land confiscated by Britain before 1920 is now fair game (*The Economist*, 2019b).

In Kericho, the capital of Kenya's tea country, emerald-green estates stretch as far as the eye can see, hugging the western escarpment of the Right Valley. Set 7,000 feet above sea level, the climate is perfect for growing tea. For Paul Chepkwony, the governor of Kericho's County, these plantations are a reminder of the way the British stiffed his Kipsigis tribe of their land. Under British rule, the colonists took half the land on which the Kipsigis grazed their cattle, turning it into tea estates. P. Chepkwony demands that the British government pay compensation to 115,000 Kipsigis and their descendants who lost their land. He also said that a ruling in February 2019 by the new land commission allowed him to increase land taxes on tea estates and demanded US$20 billion or so in profits that he claimed were illegally acquired – equivalent to nearly a quarter of Kenya's annual gross domestic product (GDP). The burden, he felt, should fall primarily on three firms that grow tea on disputed land: Finlays, Unilever and George Williamson. If they accepted the deal, they would be welcome to stay on as tenants of the Kipsigi people, he stated (*The Economist*, 2019b).

The multinationals have resisted these demands to surrender their title deeds for inspection. They have also challenged the land commission's ruling. The governor's legal adviser warned that such recalcitrance could prompt frustrated Kipsigis to take the law into their own hands. The tea companies do not take such threats lightly. In June 2019, the governor of a neighbouring county led to an invasion of an estate, uprooting tea bushes. Historic land disputes are vexing multinationals in other sectors too. Kakuzi, a big British agricultural firm and Del Monte Kenya, which grows 13,000 acres of pineapples, have faced demands to surrender large chunks of their plantations. County governors are also using their new powers to make life difficult off the farm. Tata Chemicals, an Indian soda-ash miner, has been slapped with a US$166 million land-tax bill it says it cannot pay. Local politicians are also complicating things for Tullow, an Anglo-Irish company trying to extract oil in northern Kenya (*The Economist*, 2019b).

Regarding Kenya's president, Uhuru Kenyatta, Jomo's son, aside from fears that those with land grievances could one day turn to his family's vast holdings, he presents himself as a champion of foreign investors. Yet, preoccupied by a power struggle in his government and wary of alienating voters ahead of an election in 2022, U. Kenyatta has been silent, which may damage the economy. Multinationals are not just big taxpayers but also sizeable employers. Del Monte is Kenya's largest exporter of canned pineapples. Nearly two-thirds of tea processed by big firms comes from smallholders. When landless farmers organized by the ruling party seized big commercial farms in Zimbabwe, the economy collapsed. It is true that many Kenyans have legitimate land grievances, but making implausible demands of profitable farms does not seem the best way of addressing them, according to *The Economist* (2019b).

CACAO (COCOA) AND CHOCOLATE

Cacao domestication

Traditionally, cacao is thought to have been first domesticated in Mesoamerica. However, genomic research shows that *Theobroma cacao*'s greatest diversity is in the upper Amazon region of northwest South America, pointing to this region as its centre of origin. Zarrillo et al. and Blake (2018) have reported cacao use identified by three independent lines of archaeological evidence – cacao starch grains, absorbed theobromine residues and ancient DNA – dating from approximately 5,300 years ago from the Santa Ana-La Florida (SALF) site in southeast Ecuador – the oldest site of the culture Maya-Chinchipe. These findings constitute the earliest evidence of *T. cacao* use in the Americas and the first unequivocal archaeological example of its pre-Columbian use in South America. They also show that the upper Amazon region as the oldest centre of cacao domestication yet identified.

This discovery has made the domestication of cacao 1,500 years older than previously thought, and determined the region of its initial domestication. Up to now, the oldest traces of cacao use – as a beverage and currency – were discovered in Central America, 3,900 years ago. The archaeologists thought that the trade exchanges along the Pacific Coast had resulted in bringing South American cacao plants up north. The international team of researchers who made this archaeological discovery, included scientists belonging to the University of Calgary Department of Anthropology and Archaeology, Calgary, Alberta, Canada; the University of British Columbia Department of Anthropology, Vancouver, British Columbia, Canada (Sonia Zarrillo and Michael Blake); the Department of Nutrition and Department of Environmental Toxicology, West Coast Metabolomics Center, university of California, Davis; the AGAP, University of Montpellier, CIRAD, INRA, Montpellier SupAgro, France; the Kennesaw State University Department of Geography and Anthropology, Kennesaw, Georgia, USA; the Instituto Nacional de Investigación Agropecuaria Estación Experimental Tropical Pichilingue, Quevedo, Provincia de Los Ríos, Ecuador; and to a few other institutions.

The Cacao Genetic Improvement Programme

Like many other crops, cacao is under constant threat from diseases and environmental challenges exacerbated by the tendency to grow a few varieties with similar or identical genetic traits and defects. "Most varieties grown worldwide belong to a narrow set of clones of *Theobroma cacao* selected in the 1940s," stated Wilbert Phillips-Mora, who in 2017 was overseeing the International Cacao Collection (1,235 types of cacao trees)

and heading the Cacao Genetic Improvement Programme at the Tropical Agricultural Research and Higher Education Center (CATIE, Spanish acronym) in Turrialba, Costa Rica. A narrow gene pool means that most commonly cultivated varieties of cacao are susceptible to the same diseases, and these blights can spread quickly. Cacao cultivation and production brought relative prosperity to the Caribbean Coast of Costa Rica until the 1970s, when farmers began to notice that pods on their trees were developing a fuzzy white fungal coating and eventually mummifying. The fungus – *Moniliophthora roreri* – also called monilia or frosty pod rot, soon spread around the country and by 1983 Costa Rica exports of dry cacao beans had declined by 96%. The cacao industry has never really recovered from this fungus attack in Costa Rica. "For me, the cacao industry is in permanent risk, because internationally or unintentionally, this disease could be spread in just one flight," explained W. Phillips-Mora. Increasing travel and commerce in the developing world have provided new pathways for infection. W. Phillips-Mora believed the most recent confirmed outbreak – in Jamaica in September 2016 – may have been the result of marijuana traffickers' moving between Costa Rica and Jamaica, unwittingly grabbing infected cacao pods as snacks for their boat-ride home. That outbreak has demonstrated the ability of the fungus to survive more distant travel than previously known. Other cacao-producing regions, such as West Africa – where are found the two world's biggest-producers of cacao, Côte d'Ivoire and Ghana – have been hit by similar outbreaks (Karp, 2017).

Even without frosty pod rot, cacao is a problematic crop. Other diseases – witches' broom, black pod, cacao swollen-shoot virus – also afflict the tree. Climate change may further exacerbate problems with tropical plant pathogens. These difficulties make cacao ever less appealing to producers: yields and profits are low, and the age of the average cacao farmer becoming higher. Part of the next generation seems to be abandoning the family business. Yet demand for chocolate is rising, especially as considerable markets like China and India indulge a taste for what used to be a treat primarily for American and European consumers. A chocolate shortage could happen from time to time, due to climate and pathogen impacts on the harvest or to pricing policies by the producing countries. (see below). That is where Wilbert Phillips-Mora's project comes in. The genetic diversity of cacao, on full display in the International Cacao Collection at CATIE may avert a chocolate crisis. In the early 1980s, W. Phillips-Mora worked to identify the most naturally tolerant and productive cacao trees, then painstakingly hybridized the candidates to create novel varieties. Breading cacao clones is a lengthy process and experts worldwide have largely failed in this endeavour. But in 2006, W. Phillips-Mora released his first batch of hybrid cacao varieties. In terms of disease resistance and yield, the differences were astonishing. The six hybrids produced on average about three times as much cacao as standard varieties; under ideal conditions, the most prolific hybrids can produce six times as much cacao. After an 11-year trial, a hybrid called CATIE-R6 experienced an infection rate of 5% from frosty pod rot, compared with a 75% rate for a control variety. This work carried out at CATIE was not just to increase the production of cacao, but to give the basic living conditions to the farmers, who are very poor because their system of cultivation is based on poor-yielding capacity and disease-susceptible plant material. The CATIE hybrids are now growing in all Central American countries as well as in Mexico and Brazil (Karp, 2017).

Agricultural yield and disease resistance benefit farmers, but a cacao crop is worthless if it produces bland or foul-tasting chocolate. W. Phillips-Mora's breeding programme incorporates fine flavour as a prerequisite. Cacao varieties that do not impress expert palates are discarded, no matter how well they grow. The result of this protocol is that unlike many other crops favoured for agronomics – the Red Delicious apple or the Cavendish banana – CATIE's cacao actually tastes good. Chocolate makers are roasting and packaging the beans of W. Phillips-Mora's varieties. For instance, Dandelion Chocolate, based in San Francisco, released a bar made from a mix of all six CATIE hybrids. But it should be recognized that the CATIE hybrid varieties do not offer a perfect solution to all the crop's challenges. They cannot all self-pollinate and some of the beans are small; they have not been properly tested in Africa or Asia, and they are not yet resistant to all the pathogens that afflict cacao trees globally. Field trials have been completed on a new batch of clones bred to address some of these issues (Karp, 2017).

Côte d'Ivoire and Ghana: the world's leading producers and exporters of cacao

In Ghana, the harvest of cacao beans is in full swing between October and March, in particular in the south of the country, in the heart of the Ashanti countryland. Several traders are very active during the harvest season, for instance in the village of Deduako: the trading company Nyonkopa stores the bags of beans that have been fermented and dried under sunshine, and purchased from many planters. All transactions are recorded in a register which is the first stage of traceability operations as required by the Ghanaian government. In addition to Nyonkopa, another two traders compete to buy and store the precious beans: ECOM and Produce Buying Company (PBC). They all try to convince the farmers to sell their produce and even to become trustworthy suppliers. Nyonkopa has chosen to assemble them in the church of the village and promised to allocate a pension to those farmers who would commit themselves to deliver at least 10 bags of beans per year over five years. This pension was estimated in 2018 at US$22 or €18 per month – the country's minimum monthly salary being US$50. The cacao production and transformation chain is afflicted by many problems, one of them being the ageing of the farmers and planters; this is a serious concern expressed by the companies buying and transforming cacao into chocolate (Girard, 2018a).

In Ghana, cacao production and trade is above all an affair of the state, and for good reasons: the country is the world's second-biggest producer and exporter of cocoa beans, having a 20% market share, just behind its neighbour country, Côte d'Ivoire. Thus the brown powder is the third main source of income of the country, behind gold and oil; it represents *ca*. 10% of the gross domestic product (GDP). The Ghana Cocoa Board, the governmental body better known under its shortened name Cocobed, is in charge of this whole national industry. It has the responsibility to determine the regulations regarding the production quality and to enforce them; but it is also entrusted with the task of storing the bags of cacao beans, as well as with the decision to fix the price paid to the farmers. In 2018, due to a decrease in the world market price of cacao, Ghana decided nevertheless to maintain the price paid to the farmer at the same level one year earlier, i.e. US$1,700 per ton or US$1.70 per kilogram or

US$108 per bag of beans. The farmers prefer to talk about bags regarding their output, and many of them just collect four or five bags per harvest. This is not sufficient for those small and poor farmers to benefit from the enticing programmes of such traders as Nyonkopa. Quite often the sales of cacao beans are the only source of income for these smallholders; they have therefore no other option (Girard, 2018a).

On the other side of the border, in Côte d'Ivoire, cacao price is also guaranteed by the state. That measure was taken by the president of the country, Alassane Ouattara, who decided to turn his back to the liberal policy applied to the sector and thus tried to boost national production. But the producers expressed their bitterness when the government decided in 2017 to reduce the fixed price from 1,100 down to 700 francs CFA per kilo or US$1.26 per kilo. That was a reduction of more than one-third, which was supposed to compensate the fall of cacao prices that occurred in 2017 on the global market. Such a stiff fall was due, to a large extent, to the record harvests in 2017 in Côte d'Ivoire and Ghana: they reached almost 1 million tons for the former and 970,000 tons for the second. The speculators, who forecast a global deficit, were contradicted by the real facts, and a marked decrease in global prices occurred. At the beginning of 2018, the price of one ton of the brown powder was less than US$1,900 at the New York stock exchange (Girard, 2018a).

The decision to maintain the price paid to the producers was made by the new president of the Republic of Ghana, Nana Akufo-Addo, elected in December 2016. The state had to fill the gap. Moreover, it seems that the Ghanaian government is thinking of reducing the price paid to the farmers, because the difference between the situations of the two neighbouring countries generates a lot of smuggling. "The state must subsidize the production through the allocation of *ca*. US$300 per ton of cacao," stated Krishnakumar R. Pillai, general manager of Biolands, a subsidiary of the Swiss company Barry Callebaut – the global leader of cacao trade. The calculation of the subsidy takes account of the costs of transport, storage and regulation enforcement, which must be added to the price of purchasing the beans. Part of these costs was transferred to local traders such as Nyonkopa. In fact, in 1992, the International Monetary Fund (IMF) strongly recommended to Ghana to open the commercialization of its cacao beans to international competition. As a result, even though the ex-monopolistic public company, PBC, kept a large part of the market (30%), it had to compete with many rivals, such as the Swiss trader ECOM, followed by the Singaporean Olam and Nyonkopa. All received the equivalent of US$210 per ton, but they had to manage all the operations regarding the purchase of beans and the logistics, and still to make a profit (Girard, 2018a).

But, in addition to try to make profits, the large trading companies had requested a license from the Ghanaian state to buy the cacao beans, in order to be as close as possible to the farmers. For instance, Barry Callebaut purchased Nyonkopa in 2015 – a strategic decision made by its chief executive officer (CEO), Antoine de Saint-Affrique. Barry Callebaut, which is hardly known by the large public, claims to be the world leader in the trade of cacao and chocolate products or derivatives, with an annual turnover of *ca*. 6.8 billion Swiss Francs or €5.8 billion. Its big rivals are the American Cargill or the Singaporean Olam and Wilmar. It supplies cacao to such large agrifood companies as

Nestlé, Mondelez or Hershey's, but also to the confectionery manufacturers. Part of the products – cacao, cacao butter and liquor – that are supplied to European clients, have been manufactured since the years 2000s in the factory owned by Barry Callebaut and located in the free zone of Accra (south of the city). An investment of US$17 million had been made in this respect in 2016. With a focused business plan and an annual growth objective of 4% to 6% in volume; it is crucial to have the best access to the farmers and their bags of cacao beans. Thus, Barry Callebaut, in the same way as its competitors, makes its purchases in the countries where industrial plantations of cacao trees are being extended: Ecuador, Peru, Brazil or Bolivia. However, the global leader needs the supply of the two world leading producers and exporters, Côte d'Ivoire and Ghana (Girard, 2018a).

Henceforth, the interest of Barry Callebaut in trying to consolidate the cacao chain in Ghana. For instance, in 2017, it had launched with the field-teams of Nyonkopa a vast programme of digital registration of the cacao farms or plantations, with additional information on the farmers' practices, their age, their household, etc. In 2018, *ca*. 25,000 farms/plantations had been recorded out of the *ca*. 800,000 existing in the whole country. This figure showed that the farms were very small, the average acreage not exceeding 2 hectares. Not only the size of the plots was small, but also the cacao trees were often old and diseased. Consequently, the average productivity was low: *ca*. 372 kg of beans per hectare. For Barry Callebaut, the real challenge was to increase this productivity, while at the same time restructuring and modernizing the farms. Also the Swiss trader is conscious of the consumers' demands about the conditions of cacao production. In 2016, it launched a world programme called "Forever Chocolate", whose objectives were to: completely eliminate children's work by 2025; and at the same date withdraw 500,000 farmers from extreme poverty, living with US$1.9 per day; use 100% of "sustainable" ingredients in the production stages; achieve a positive carbon balance, as well as a zero rate of deforestation. On the government side, there is a need to struggle against illegal gold washing or panning, which contaminates waters and soils and does attract youth instead of farming. Gold washing is a politically sensitive issue, because there are many Chinese people involved in this illegal venture. Also, the government of Ghana wanted to reduce its dependence on the world-market prices of cacao – in 2018 it exported 70% of raw cacao whereas adopting a policy to create more added value in the country. The government was negotiating a loan of *ca*. US$750 million in order to facilitate the gradual replacement of diseased or too old trees and in 2019, a chocolate factory was, for the first time, producing and selling chocolate made in Ghana. This example should be followed by other facilities, because the "best" chocolate in the world deserves it (Girard, 2018a).

Ghana and Côte d'Ivoire united to confront cacao traders and transformers

On 12 June 2019, in Accra, both countries announced they had suspended the sales of cacao beans to be harvested in 2020-2021 – sales are generally made by anticipation; that measure will last until the traders, transformers and chocolate-makers accept to pay the bottom price of US$2,600 or €2,300 per ton of cacao beans. In Côte d'Ivoire, the director-general of the Coffee-Cacao Council (CCC), Yves Koné justified

the decision: "We want that our producers do not any more depend on the vagaries of world-market prices and that they live decently from their work". The farmers/planters, who generally cultivate small plots, do not benefit properly from the cacao chain value. According to the International Cacao Organization, only 5% to 10% of the US$100-billion annual sales of chocolate is recovered by these farmers; and in constant dollars the bean price had been divided by almost four in 40 years. "The requested price, just a little more than the 2019 world-market price – *ca*. US$2,500 per ton –, is not extravagant. This is a commendable request that makes sense, but I am doubtful about its sustainability," commented a trader regarding this new alliance between the two-biggest producers of cacao and the likelihood of its success (Bensimon, 2019).

It should be recalled that under the impulse of both presidents, Alassane Ouattara of Côte d'Ivoire and Nana Akufo-Addo of Ghana, the two countries have become closer since 2017. They, for instance, succeeded in reducing the difference between the bean prices in each country – often leading to smuggling – and also in harmonizing their sales system. For both nations, the issue of rewarding the smallholders' work is an extremely sensitive one. According to some estimates, the income from cacao provides the source of living of almost one-third of Côte d'Ivoire population. However "the decision to apply a bottom price of US$2,600 a ton of cacao will not withdraw the farmer/planter out of poverty. If he could pocket 70% of this price, while producing one ton per year hopefully, he will get for himself and his household just US$150 per month. One way out would be to triple the buying price of cacao, even though such a measure would likely worsen overproduction of the raw material," explained one executive involved in cacao production and transformation. According to many experts, the main measure that should be taken by both countries in order to have a better income would be to firmly monitor their production. Thus, in Côte d'Ivoire, where almost one-quarter of the cacao is illegally withdrawn from protected forests, the overall production has almost doubled over a decade (Bensimon, 2019). It is worth recalling that between 1987 and 1988, the first and late president of Côte d'Ivoire, Félix Houphouët-Boigny, declared the "cacao war," while he was struggling against "the secret forces of the market." He decided to prohibit any export of cacao, thus hoping that the world-market prices would rise. But after hoarding hundreds of thousand tons of cacao during 16 months, the late president surrendered and sold the country's cacao beans at knockdown prices. Some thirty years later, by mid-2019, the cacao-chain actors were wondering what would be the consequences of the new battle put forth by both of them. According to renowned experts, the main chocolate manufacturers such as Barry Callebaut, Cargill or Olam, would be inclined to accept the decision of the two main African producers; because they will adapt their selling prices when they deal with the chocolate-manufacturers, and also because they have no chance in the short term, to purchase the same volumes of cacao beans from other producers in the world. Another key issue would be the reactions of the markets: the bottom price may be converted into a ceiling price; "In such a volatile environment, would the funds take the risk of a prefinancement or would they play in favour of a decrease in the world-market prices? The buyers may also be tempted to buy at the last moment. Finally, will the distributors be involved in the bargain? (Bensimon, 2019).

The rising market of posh chocolate

Posh chocolate shops are springing up in the hip neighbourhoods where coffee culture long ago took root. All the talk is of aromas and sustainability. "Coffee has paved the way for chocolate," stated Lani Kingston, the main manager in London of Mast Brothers, a well-known Brooklyn-based chocolate-maker that came to Britain in 2015. More established chocolatiers are trying to do for chocolate what Starbucks once did for coffee – investing a commoditized product with a dash of high-street chic. In 2015, Ferrero Rocher, an Italian brand, bought Thorntons, a United Kingdom chocolate retailer with almost 250 stores. Lindt and Sprüngli, owners of Switzerland's best known brand, aimed to become the world's biggest retailer of premium chocolate in four years. It expected to add 65 stores in 2016, after 50 new ones in 2015 (*The Economist*, 2016).

Posh chocolate is where the money is. Euromonitor stated that world consumption of all chocolate had been stagnant during the five-year period, 2011-2015, mostly because rich-world consumers were eating healthier snacks. But sales of dark chocolate grew by 5.1% and 3.3% in 2015 in the United States and Western Europe, respectively. Doug Hawkins of Hardman Agribusiness, an advisory firm, stated that most cacao was produced by smallholders who had not increased supply in recent years as much as other commodity producers, helping push up prices. Posh chocolatiers such as Britain's Hotel Chocolat, with higher margins, can absorb that better than big brands such as Mars. Rising raw-material costs and stagnant demand bode less well for big manufacturers. That may be one reason Mondelez International, owner of Cadbury, has bid for Hershey's, another American firm. They are eyeing potential chocoholics in China and India. But again, it is quality chocolate that will most appeal to elites with purchasing power. As Euromonitor noted, it would take an Indian on average a monthly salary to buy the chocolate a Briton eats in a year (*The Economist*, 2016).

The multiplication of highly creative chocolate brands in France

"By the mid-1980s, chocolate was either Swiss of Belgian-made. Nowadays, the best chocolate is French made," stated Jacques Pessis, president of the Club of Chocolate Devourers, which establishes an annual list of its favourite chocolatiers. By the early 2015, this list included some 160 chocolate craftsmen, including 35 in Paris. "There are more and more craftsmen-chocolatiers whose diversity and quality are really impressive," he added. In a few decades, particularly with the annual fair bearing the name of *Salon du chocolat*, which celebrated its 25th anniversary in 2019, chocolate has become a French highly-valued brand. Chocolate is emblematic of delicacy, refinement, even of luxury, that was formerly associated with pastry-making, but it has now its own niches and creativity. In Paris, in the first district (Saint-Honoré street) or in the Saint-Germain-des-Prés district – places of high-luxury shops –, one can see almost next to each other the shops of Jean-Paul Hévin, Pierre Marcolini, Richard-Michel Cluizel, Patrick Roger, Philippe Pascoët, Debauve and Gallet, Arnaud Lanher, Henri Le Roux, Jean-Charles Rochoux, etc. How therefore a pastry ingredient has become a product *per se*? This revolution started with Gaston Lenôtre, a highly renowned master pastry-maker and founder of the Ecole Lenôtre in 1971 – a recognized reference place where chocolate is the main focus of students' creativity and work. G. Lenôtre trained

many generations of pastry-makers and chefs, from Alain Ducasse to Pierre Hermé, and also through Christian Constant, Michel Chaudun and Robert Linxe – the founder of the *Maison du chocolat* who passed away on 11 December 2014. Robert Linxe was nicknamed the "ganache wizard," because he widely disseminated this filling made of a mixture of chocolate, butter and cream; this has become one of the pillars of the chocolatier art, in addition to its economic role, cream being less costly than chocolate (Labro, 2014).

Behind the incredible success of contemporary chocolatiers, there is an ubiquitous brand based in Tain-l'Hermitage (Drôme department, Rhone valley): Valrhona bears the name of the Rhone valley and it supplies all the French renowned chocolatiers with a cover chocolate, using a variety of cacao, Guanaja, containing 70% of black cacao. This had a bewildering impact on the chocolatier profession. The story of Valrhona started with the launching, at the end of the 1980s, of the *L'Ecole du grand chocolat* (School of the Premium Chocolate) in Tain-l'Hermitage; that was an unprecedented event for a raw-material supplier. Thereafter, Valrhona opened a similar school in Versailles (2010), Tokyo, and then a fourth school, the School of Premium Chocolate Brooklyn Pastry Class, in 2014, in the borough of Dumbo, Brooklyn, New York. In 2015, it was scheduled to launch the Valrhona School of Taste and to organize workshops focused on sensorial analysis, so that professionals will not only learn how to make chocolate, but also how to describe and talk about chocolate taste (Labro 2014).

Many factors, like in wine-making, interact in the search for the best cacao and the finest aromas: the variety, the terroir, the fermentation and drying of the beans, and their toasting. Valrhona has the capacity to master the whole chain of cacao processing. It works with many smallholders in 15 different countries. It is not therefore surprising that nowadays a chocolatier uses such labels on his chocolate tablets as "*grand cru*" (great vintage) and "pure origin"; the countries of provenance of these chocolates are Madagascar, Java, the Dominican Republic and Trinidad and Tobago. There are many French chocolatiers who have decided to devote all their time and art to chocolate making. This is the case of Jean-Paul Hévin, who ownins five shops in Paris and 13 overseas, and is considered as the pioneer of the new generation of chocolatiers. Jacques Genin, initially trained as a cook and pastry maker, has decided to eliminate any pastry from his shopwindows. In Paris' fashionable district, le Marais, he only prepares pastries on request and devotes most of his time to make chocolates and other confectioneries of which he holds the secret: fruit or vegetable jellies, toffees or fudges and nougatines. Like J. Genin, a craftsman, Patrick Roger, also considers that the chocolate saved him, after leaving school without any degree and abandoning pastry-making; he discovered an innate skill for chocolate-making. He owns more than nine shops in the Ile-de-France region – the very vast region around Paris – and he makes chocolate masterpieces as well as an amazing range of candies (Labro, 2014).

Regarding Pierre Hermé, renowned for his *haute-couture* – high and posh – sweets, combining sugar with luxury, he has been able to open 13 selling points dedicated to chocolate and macaron, compared with only two where pastries can be purchased. These selling points are addressing young and foreign consumers; their logistics is quite simple: it is much easier to transport and conserve chocolates made in Alsace

than big pastries which require a confection team on the site. Sébastien Gaudard also thinks that "pastry-making is more delicate and haphazard, there are daily losses, while chocolates can be prepared in large quantities and stored for a long time. Chocolates represent 30% of the annual turnover of S. Gaudard's business. Chocolate-making has been considered a profit-making sector for a long time, particularly by the businessman David Holder, who purchased the Ladurée brand in 1993. He created in 2012 a new brand: *Les Marquis de Ladurée* (The Marquisates of Ladurée). Also, chocolate exerted its fascination on the famous Alain Ducasse, trained by G. Lenôtre, Chaudun and Bernachon, who decided to create a factory producing his own chocolate, starting from cacao beans. The results are amazing: sweetness without borders, playing on the bitter and granulous structures and tastes, both fashionable and posh. The Emperor of the French gastronomy, who in fact manages a very big business, has taken the lead with his own factory in putting at the forefront chocolate-making and its highly-creative products (Labro, 2014).

BEERS AND WINES

1920-1933: the Prohibition in the United States

In December 1917, the American Congress approved the 18th Amendment of the Constitution by overwhelming majority (282 against 128 at the Chamber of Representatives and 47 against 8 at the Senate). This Amendment prohibited "the production, sale or transport of alcoholic drinks" across the United States. The application bill, drafted by Andrew Volstead, a representative of Minnesota, prohibited any alcoholic beverage containing more than 0.5 degree of alcohol; it was therefore banning beers and wines. On 17 January 1920, one year after the ratification of the Amendment by two-thirds of the federate States, all America was "*dry*"; at least officially (Leparmentier, 2020a).

In 1920, Westerville, Ohio, had become the "capital" of the prohibition of alcoholic beverages. The 40,000 inhabitants of that town claimed: "one hundred years ago we were a small town of 1,500 inhabitants that changed American history through becoming the seat of the powerful and uncompromising Anti-Saloon League (ASL)." It was true that in a few years, the ASL protestant militants had succeeded in persuading Americans to ban the production and consumption of alcoholic beverages, while a lot of organizations had failed to do so. In front of the city hall of Westerville, a monument has been built to commemorate the centenary of the Prohibition; that was the work of the artist Matthew Gray Palmer. Under a ripped open barrel, there is an enormous wedge that fractures a marble block that is supposed to represent America. The wedge has two faces that could be a summary of American history: on one face, the good reasons that led to the adoption of the Prohibition, and on the other the drift that led to its abolition, thirteen years later. In Westerville, there are many people who think "that the present divisions remind us of those of yesterday": rural inhabitants against city dwellers, protestants against Catholics, "autochtonous" Americans against Irish, German, Jewish or Italian immigrants (Leparmentier, 2020a).

How the Prohibition had become a necessity in the eyes of the "true" Americans? Because the country was a "nation of drunk people" – a phrase of the American film director Ken Burns, who referred to as a documentary on the Prohibition. During the 19th century, water was often undrinkable, while alcohol was flowing freely; in 1830, the average consumption of an American was 27 liters of pure alcohol per year, that is three times more than nowadays. Whiskey, of a mediocre quality, was wreaking havoc, and in 1840 six alcohol-addicted people of Baltimore, Maryland, created a temperance movement, the Washingtonians. The crusade against alcohol was rapidly

overtaken by the protestant churches which wanted to impose this temperance by law. At this time of history, Westerville came at the forefront: this small town was colonized in 1818 by three Methodists coming from New York State – the Westervelt brothers. At the end of 1840, these brothers used to welcome in their farm religious seminars and they granted land to create a university that was expected to admit women and Afro-American people. Although this attitude may have reactionary aspects, this protestant movement was also promoting the abolition of slavery as well as women's empowerment. It was also able to create a wide-ranging coalition against alcohol consumption. It was not therefore surprising that in 1858, when the village district of Westerville was created, a temperance law prohibited the sale of alcoholic beverages. Westerville followed the example of Maine, an Atlantic Coast State, where the consumption of alcohol by the sailors and workers was far from being under control. Maine became "dry" (instead of "wet") in 1838, and it was followed by a dozen of States. In 1910, half of the American population was living in "dry" territories (Leparmentier, 2020a).

In 1909, Westerville became the seat of ASL, founded 16 years earlier, and earned the little of the "world's capital of dryness". Westerville was close to Ohio's capital, Columbus, it could be reached by the railway, it had a post office and could grant land free of charge. The ASL was therefore able to build printing houses that overflowed America with propaganda against alcohol consumption. The Midwest was full of saloons where men were spending their wages and around which crowds of women and children used to pray but also to throw stones and axes against them, because they were such a disaster for the families. One of these militant women was Carry Nation (1846-1911), who was convinced that she was designated by God to struggle against alcohol (Leparmentier, 2020a).

For decades, the sales of alcohol at the national level have been growing thanks to the German brewers, in particular Adolphus Busch (1839-1913), the big producer of the beer of Saint Louis, Missouri. Their business was prosperous and they behaved as good citizens because they, for instance, funded the war against Spain, in Cuba, in 1898. As they held under control the saloons, they could buy popular votes. And they were sure that Washington, D.C., could prohibit the production and consumption of beer, because the taxes on beer financed *ca*. one-third of the Federal budget. However, change was coming sooner: the ASL acting from Westerville was lobbying at the political level, as did the German brewers. In Washington, the ASL representative, Wagner Wheeler (1869-1927) helped candidates to succeed or to fail, depending on their support for a "dry" or "wet" country; the ASL target was the 4% of electors that change allies during an election, with a view to reaching a vote that suits its ideology. The same method was used later on by the weapons or rifles lobby. The ASL facilitated a major event in 1913 when the 16th amendment to the Constitution was ratified, authorizing an income tax. The Federal Government could therefore have a financial support independent from the taxes on alcohol (Leparmentier, 2020a).

The Prohibition had become possible, and at the beginning of the 20th century a new coalition against alcohol was formed, including big businessmen such as John D. Rockefeller or Henry Ford, who were convinced that the consumption of alcohol

reduced workers' productivity; the trade-unions joined the coalition, as well as the Afro-Americans who were victims of this rife after the abolition of slavery; the women were also part of it, because they were quite often the victims of their drunk husbands and they were struggling for their right to vote – this was granted eight months after the vote on The Prohibition. Another factor that played in favour of The Prohibition was the declaration of war by the United States against Germany at the beginning of 1917; an event which blacklisted the German brewers who lost their influence. After the abolition of The Prohibition in 1933, Westerville, which kept its conservative position and behaviour, abolished The Prohibition in 1933, but it did reestablish it after a few months and until 2005. The struggle of this small city of Iowa against alcoholic drinks has left an imprint, e.g. a referendum is organized by the citizens when a bar is to be opened in the city (Leparmentier. 2020a).

Alcohol overuse in the United States: a persistent public-health problem

The journalist Gabrielle Glaser (2014) in her book titled *Her Best-Kept Secret*: *Why Women Drink – and How They Can Regain Control*, uncovers a hidden-in-plain-sight drinking epidemic. G. Glaser is the first to document that American women are drinking more often than ever and in even-larger quantities. She looks at the roots of the problem, explores the strange history of women and alcohol in America, drills into the emerging and counterintuitive science about that relationship, and asks: Are women getting the help they need? Is it possible to return from beyond the sipping point and develop a healthy relationship with the bottle? She shows that as scientists and health professionals learn more about women's particular reactions to alcohol, they are coming up with new and more effective approaches to excessive drinking. In that sense, G. Glaser offers modern solutions to a very modern problem (Glaser, 2014).

Alcohol overuse indeed, remains a public-health problem and was responsible for more deaths, as many as 88,000 per year in the United States in 2017-2018. While light drinking has been shown to be helpful for overall health, since the beginning of this century there has been about a 50% uptick in emergency room visits related to heavy drinking. After declining for three decades, deaths from cirrhosis, often linked to alcohol consumption, have been on the rise since 2006. Rick Grucza, an epidemiologist who has been studying alcohol consumption patterns for more than a decade, stated that the numbers were incontrovertible. Since the early 2000s, according to five government surveys, R. Grucza has analyzed binge drinking – often defined as five per day for men and four per day for women – was on the rise among women, older Americans and minorities (Glaser, 2018).

It is a sad fact that many people learn to drink excessively in college. Many alcohol researchers and substance-use clinicians believed the steady increase in problem drinking arose from a deeply felt sense of despair: "Since the attacks of 9/11 on New York's World Trade Center, we have been in a state of perpetual war, and a lot of us are traumatized by that," explained Andrew Tatarsky, a clinical psychologist who specializes in treating people with substance-use disorders. The superrich might be making money, A. Tatarsky stated, but many others are just worried about making ends to meet. Uncertainty about tax changes and the cost of health insurance only

adds to their burden. And the culture about drinking, the *way* we drink, has grown more intense. Since college excessive and binge drinking for many continues through early adulthood with after-work happy hours, so much so that Thursdays, in many circles, have become "Little Friday" – a code for hitting the bar after work (Glaser, 2018).

Cues from popular culture make alcohol look glamourous and fun: "They send the message that you are missing out if you are not up on the latest cocktail," explained Carrie Wilkens, also a clinical psychologist treating substance abuse. And as adults age and feel burdened by the responsibilities of family and work, drinking can be a stress reliever. Nobody wants to view himself as an addict, and the fact of the matter is most problem drinkers are not. Many people are afraid even to discuss the topic with their doctors for fear of being labeled. But in fact, researchers have long shied away from using the term "alcoholic", because it is both negative and fated. The new term to describe problematic drinking is alcohol-use disorder. Only about 10% of the estimated 16 million Americans who abuse alcohol fall into the severe category, according to Reid Hester, a clinician psychologist who has been studying addiction for more than 40 years. While those in the severe category might need to abstain from drinking, the vast majority of others do not, he explained. Newer treatments embrace an array of techniques and are effective for those with mild and moderate problems. A great deal of research supports the use of anti-craving medications, such as naltrexone, and harm-reduction therapy, which Sheila Vakharia, an assistant professor of social work at Long Island University, said provided practical tools for solving behavioural problems. A. Tatarsky, for instance, teaches patients to learn how to "surf" their urges – taking 15 seconds to notice the emotion that might be causing them, and then substituting healthier behaviours such as breathing exercises. He also taught strategies: "Before you go to a party, before you set out on your week, it is useful to have a plan, just like athletes have game plans." R. Hester founded Checkup and Choices, a company that sells a web-based tool for reducing drinking. Since 2003, more than 60% of the 22,000 users of the app have been women (Glaser, 2018).

Drinking poses special risks for women of course. They are almost twice as likely as men to have anxiety disorders, which they often medicate with alcohol. And biologically, women are more at risk for alcohol's intoxicating effects. Because of the stigma associated with alcohol problems, women – especially those with children – are less likely to seek help. Reid Hester believes that since web-based programmes are confidential and available around the clock, women are more likely to turn to them. The news about our alcohol habits may seem grim, but there is room for hope. In this regard, Gabrielle Glaser gave the example of a Virginia businesswoman who found her drinking spiraling out of control after her company went under in 2009. She used a harm-reduction suggestion of abstaining for 30 days – at first a challenge – and then reintroduced alcohol while chronicling her thoughts, feelings and cognitive abilities after each drink on note cards on her refrigerator and kept them up for a year as a reminder of how bad she felt after a third drink ("sloppy and maudlin"). Years on, she still thinks about those notes, especially during the stressful times. More often than not, she switches to water. "Happiness", she stated, "does not come in a bottle" (Glaser, 2018).

The powerful alcohol lobby in France

On 14 November 2019, the spokesperson of the General Trade Union of Champagne's Wine Makers declared that there will not be a "dry January" – i.e. the suspension of alcohol consumption during a month –, a measure that was supported by the national agency Santé publique France (Public Health France). In addition, at the beginning of January 2020, an editorial of *La Revue du vin de France* (The Review of French Wine) started bashing all the "hygiene associations which spread fear through relating wine consumption with death and cancer." The same editorial did not hesitate to talk of a "plot", of a "prohibition camarilla", "censors, virtuous leagues, as well as of the mortiferous constraints of the Evin law", which regulates the consumption of tobacco and alcohol. "We must react, stated the editor-in-chief of the review, and stop the financing of parasitic associations which recommend the ruin of our viticulture sector and the denial of our culture" (Horel and Santi, 2020).

What "dry January" means? There are many people who are tempted by this idea, i.e. to make a pause regarding drinking alcoholic beverages, after the celebrations of Christmas and the New Year. By 20 January 2020, there were 8,491 interviewed persons who were willing to do so. The French agriculture minister was not supportive of this approach, preferring the moderation of drinking the year long than its prohibition during a single month. But despite this lack of support by the public authorities, about 30 associations carried out this activity. Some of them underlined that although alcohol could bring some pleasure, it has always a risk; that a "dry" month could be an opportunity to make people, especially youth, realize the dangers of alcohol overconsumption. These experiences have been tried during several years across the world. For instance in 2019, four million people have responded positively to the challenge of a "dry" January in the United Kingdom, initiated in 2013 by Alcohol Change UK. In Belgium, in February 2020, that will be the fourth edition of the *Tournée minérale* (Mineral Water Round). Several studies have shown the health benefits of this "dry" month: a better concentration, a better sleep and more energy. It also seems that after a "dry" month there is a significant decrease in alcohol consumption – which obviously the wine lobby is afraid of (Horel and Santi, 2020).

Whatever the duration of non-alcohol consumption, the producers of alcohol do not want to speak of abstinence. Instead of temperance, they prefer to talk about moderation all the yearlong. They advocate and make advertisement of it and promote some "consumption yardsticks". Such as the well-known references "2.3.4.0" which means 2 alcohol units for women, three units for men, 4 units for drinking occasions and 0 alcohol "in risk conditions (pregnancy, medicine treatment) and at least one day per week for all other conditions." One unit is equivalent to 10 g of alcohol or 10 cl of wine (12°), 25 cl of beer (5°) or 3 cl of a distilled spirit (40°) such as whiskey. These "yardsticks", based on a 1980 recommendation of the World Health Organization (WHO), lost ground and were progressively abandoned in the information campaigns about alcohol drinking. In 2001, scientific studies establish a relationship between drinking alcohol and the risk of cancer. Public authorities therefore decided to put these yardsticks in the hands of health professionals, which use them as threshold in order to detect overconsumption. But the alcohol lobby decided to use the same

yardsticks with a view of promoting "responsible consumption". In 2007, the structure in charge of this lobbying was called "With Moderation!" At the beginning, it was a crisis structure against the Evin Law, adopted in 1991. At its helm were three important businessmen – Patrick Ricard, Bernard Arnaud and Antoine Riboud, who owned the beer brand Kronenbourg at that Time. It became an association called Entreprise and Prevention, and later on, "With Moderation!" (*Avec Modération*!) The exclamation point had a festive meaning and suggested that the association was not a lobby, but was doing prevention (Horel and Santi, 2020).

In 2015, just before Christmas, the association Vin & Société (Wine and Society) launched its own promotion campaign for the consumption yardsticks. The campaign was carried out by the big and powerful communication company Publicis: advertisements in the press, social networks all designed to express that "To like wine, it is also to have an ounce of common sense or reason." This logo was printed on a background of full glasses and grapes transformed into small and nice persons. The Health High Authority (HAS, *Haute Autorité de Santé*) expressed its anger against this "advertisement campaign", which "transforms risk thresholds of alcohol consumption that need medical assistance into 'yardsticks' for an 'acceptable' consumption of alcohol." In fact, since the late 2000s scientific studies have resulted in the elimination of the myth that underlined the eventual benefits of alcoholic beverages consumed with "moderation." Cancer risk eliminates those "beneficial" effects, in particular on the cardiovascular system that have been claimed for three decades by the wine lobby. All alcoholic beverages – beer, wine or rhum – suffer no exception. Alcohol is the second cause of premature avoidable death after tobacco; it is the cause of 41,000 deaths in France every year (2018), including 16,000 due to cancer, according to the French Weekly Epidemiologic Bulletin (*Bulletin épidémiologique hebdomadaire*) of Public Health, published in February 2019. Binge drinking is becoming common among youth. And the social and sanitary weight associated with alcohol overconsumption, such as casualties, violence, suicides and admission to the hospitals' emergency departments. Even though alcohol consumption has decreased since the 1960s in France, it reached nevertheless an average of 11.5 liters of pure alcohol per person in 2018. France is at the third rank among the 36 countries of the OECD (Organization for Economic and Cooperation Development) that overconsume alcohol (Horel and Santi, 2020).

In August 2018, an important study carried out by several dozens of researchers, and published in the *Lancet* came to the following conclusion: "The surest level of alcohol consumption is "0" … "Our results should lead to the revision of the policies aimed at struggling against alcoholism and the associated health programmmes, and to make abstinence recommendations." In March 2019, the interministerial commission for health published new and more restrictive yardsticks, called "consumption yardsticks for lesser health risks." They stated that "alcohol consumption should be limited to a maximum of two glasses of wine per day, and not every day systematically," and this message was based on the advice of the experts of Santé Publique France (Public Health France) and of the National Cancer Institute (INCa). "This meant a maximum of ten glasses per week" and "no consumption at all some days of the week." To reinforce this message, the health minister at that time, Agnès Buzyn, who already had irritated the wine lobby when she was at the head of the National Cancer Institute between

2011 and 2016, bluntly declared in February 2018 during a public television channel interview: "Scientifically, wine is an alcohol similar to the others. The French population is led to think that drinking wine is beneficial … This is wrong." "The second message she delivered was not "soothing the ears" and this was when she decided not to put wine on the tables of the meals served in her ministry. "The real fact is that alcohol is not good for health since the first glass and that is proportionate. Everyone should like to state: under such threshold there is no risk"… "In fact, 'with moderation' is a bad message nowadays. The true public-health message would be: alcohol is harmful to health" (Horel and Santi, 2020).

The agriculture minister at that time, Didier Guillaume, responded to his colleague on the same television channel: "I do not like to live in a hygienist society, a society where everything would be forbidden, where we cannot laugh or enjoy entertainments, where we cannot eat what we are fond of, or drink what we like. All this with moderation." That was the usual attitude of the agriculture minister versus his public health colleague; he is supposed to protect or to support the alcohol business, i.e. a sector whose annual turnover was more than €8.5 billion regarding beers and spirits and €16 billion regarding the vine-growing and wine-making and sales businesses (the figures were those published in 2013). While Santé publique France has devoted €4 million to alcohol-consumption prevention, the investments made in advertisement campaigns by the alcohol lobby were more than €345 million in 2018, according to the figures provided by the association Vin & Société. By the end of June 2018. the alcohol lobby, including the Association of French Brewers, the Spirit French Federation, the French Federation of Aperitive Wines and Avec Moderation! (With Moderation!), devised 30 measures among which they committed themselves to "promote a 0 alcohol consumption during pregnancy" – one child out of 1,000 is born with fetal alcoholization syndrome. But in October 2019, Vin & Société proposed its own version of prevention which raised the anger of public-health professionals. The campaign was tilted "A good wine can obviously wait for nine months," and it seemed to suggest that drinking and having a child are put on the same level, and that drinking again after the delivery was an acceptable beaviour. This "plan of the alcohol lobby was not approved by the public authorities," explained the health ministry in a message sent to the French daily newspaper *Le Monde*. "Prevention is obviously part of the ministry's responsibilities and a priority for which the minister accepts full responsibility. The objectives and the means to carry out prevention activities are entirely part of the public authorities' mission, even though the wine or spirit producers are invited to participate in this operation " (Horel and Santi, 2020).

Finally, it is worth recalling the following figures published in *Le Monde* with the article of Horel and Santi (2020).

- 23.6% of French people, aged between 18 and 75 years, consume more alcohol than recommended for a lesser health risk, i.e. no more than two glasses of wine per day and not every day, with a maximum of ten glasses per week (2017).
- The annual average of alcohol consumption was estimated at 11.7 liters of alcohol per person in 2018. France was just behind Austria (11.8 l of alcohol) and Lithuania (12.3 l of alcohol per person per year).

- In 2017, 10% (national average) of French adults (18-75 years) consumed alcohol every day. The upper figure (12.6%) was found in the southwest of the country, followed by the centrewest (12.3%) and the north (11.5%).
- In 2015, the number of deaths due to alcohol overconsumption was estimated at 41,000, including 30,000 men and 11,000 women.
- Among these deaths: 15,931 cancer cases; 9,897 cardiovascular diseases; 6,780 digestive tract diseases: 5,432 casualties and suicides; 4,893 liver diseases; 3,436 colorectum diseases; 2,587 esophagus diseases; 1,523 pharynx diseases; 1,130 mouth diseases; 550 larynx diseases; and 1,812 breast illness (only for women); 3,040 other diseases.
- There were *ca*. 1,000 deaths per year caused by road accidents and due to alcohol, according to the National and Interministerial Observatory for Road Security.
- The social and economic cost of alcohol overconsumption in France has been estimated at *ca*. €120 billion per year. Social cost includes the loss of human lives, a lower quality of life, loss of production and the cost for public financing (e.g. health-care costs, preventive measures, etc.).
- The economic weight of the alcoholic-beverage sector (wines, champagne, spirits and beers) can be summarized as follows: 500,000 direct and indirect jobs depending on viticulture and on wine / spirit businesses; €13.2 billion is the annual turnover for the exports of still wine (€6 billion), champagne (€2.9 billion), and spirits (€4.3 billion).
- In 2018, France has produced 4.6 billion liters of wine, i.e. 17% of the global wine output.
- The beer market, dominated by Heineken and Kronenbourg (Carlsberg), has been valued at €3.9 billion in 2018, according to the data provided by French brewers.

Yeast: the driving engine of alcoholic fermentation

Since prehistoric times, humans have exploited the capacity of the common baker's yeast, *Sacchromyces cerevisiae*, to convert sugars into ethanol and desirable flavour compounds to obtain foods and beverages with a prolonged shelf-life, enriched sensorial palate, improved digestibility, and an euphoriant effect due to the presence of ethanol. Whereas the use of pure cultures started well after the pioneering work of Pasteur and Hansen in the 19th century, early brewers, wine-makers and bakers had already learnt that inoculating unfermented foods with a small portion of fermented product resulted in fast and more predictable fermentations. This so-called "backslopping" might have resulted in yeast lineages that grew continuously in these man-made environments and lost contact with their natural niches, providing a perfect setting for domestication. However, strong evidence for this hypothesis is still missing and it remains unclear whether industrial yeast diversity in shaped by selection and niche adaptation (domestication) or neutral divergence caused by geographic isolation and limited dispersal (Gallone et al., and Maere and Verstrapen, 2016).

Domestication is defined as human selection and breeding of wild species to obtain cultivated variants that thrive in man-made environments, but behave sub-optimally in nature. Typical signs of domestication, including genome decay, polyploidy, chromosomal rearrangements, gene duplications and phenotypes resulting from human-driven selection have been reported in crops, livestock and pets. Several studies have recently investigated the *S. cerevisiae* population by sequencing the genomes of hundreds of different strains, providing a first glimpse of the complex evolution of this microbial species. However, most of these studies focused primarily on yeasts from wild and clinical habitats and often include only a limited set of industrial strains, mainly originating from wine. Moreover, most studies use haploid derivatives instead of natural strains and can therefore not explore typical patterns of domestication like polyploidy, aneuploidy and heterozygosity. The use of haploids also excludes a large fraction of industrial *S. cerevisiae* strains that have lost the ability to sporulate, such as the vast majority of beer yeasts. Nevertheless, some studies already revealed signs of domestication in wine strains, such an increased resistance to copper – present in grapevine pesticides – and sulfite (used as a preservative in wine). An in-depth investigation of strains originating from other industrial niches was still necessary (Gallone et al., and Maere and Verstrepen, 2016).

A group of researchers, belonging to Belgium and United States institutions – including Brigida Gallone of the Laboratory for Genetics and Genomics, Centre of Microbial and Plant Genetics, University of Leuven, and of the Department of Plant Biotechnology and Bioinformatics, Gent University; Steven Maere of the same department of Gent University; Kevin J. Verstrepen of the Laboratory for Systems Biology, VIB, Bio-Incubator, Leuven; and others from a few United States biotechnology companies (San Diego, La Jolla, Encinitas, California) – have described the high-quality sequencing, *de novo* assembly, annotation and extensive phenotyping of 157 *S. cerevisiae* strains used for the industrial production of beer, wine, bread, spirits, *saké*, and bioethanol, in their natural ploidy. Their data reveal that industrial yeasts are genetically and phenotypically distinct from wild strains and stem from only a limited set of ancestral strains that have been adapting to man-made environments. They further diversified into five clades: one including Asian strains such as *saké* yeasts, mostly containing wine yeasts, a mixed clad that contains bread and other yeasts, and two separate families of beer yeasts (Gallone et al., and Maere and Verstrepen, 2016).

While most of the clades lack strong geographical substructure, one of the beer clades contains geographically isolated subgroups of strains used in continental Europe (Belgium/Germany), the United Kingdom, and a recent sublineage of United States beer yeasts that diverged from the British sub-clade during colonization. Interestingly, those beer yeast lineages exhibit clear and profound hallmarks of domestication, more so than the other lineages. The shift from variable, complex and often harsh environments encountered in nature to more stable and nutrient-rich medium favoured specialized adaptations in beer yeasts, but also genome decay, aneuploidy and loss of a functional sexual cycle. Specifically, the researchers found evidence for active human selection, demonstrated by convergent evolution for efficient fermentation of beer-specific carbon sources, mainly through mutations and duplications of the MAL

(Maltose) genes, as well as non-sense mutations in PAD1 and FDC1, which are involved in the production of 4-vinyl guaiacol (4-VG), an undesirable off-flavour in beer. These results further suggested that beer-yeast domestication was initiated hundreds of years ago, well after the first reported beer production, but before the discovery of microbes. Together, all these results have revealed how today's industrial yeasts were the outcome of centuries of human domestication and they provide a new resource for further selection and breeding of superior variants (Gallone et al., and Maere and Verstrepen, 2016).

Although domestication led sexual reproduction to decay, traits useful for life in a brewery became more common. The researchers found that genes involved in the fermentation of maltose, the main sugar found in beer, were duplicated several times, allowing beer yeasts to complete the fermentation process more rapidly than their wild ancestors. Similarly, wild yeasts typically carry genes associated with a range of unpleasant flavours; and these genes were rare in the culinary ones. Intriguingly, all these signs of domestication were far stronger in the 102 brewing strains that the researchers studied than those in the wine strains. Yeast domestication began in the 1500s and was more pronounced in brewing than it was in wine-making. Brewing yeasts were likely to breed continuously in a man-made environment, since they are recycled after each fermentation batch and beer is produced all the year round. By contrast, wine yeasts are only grown for a short period every year, and spend much of their lives in and around the vineyards where they are subject to intermingling with wild strains, so are subjected to natural selective pressures. The researchers went on to select a strain of beer yeast that shows very efficient fermentation, but also produced a spicy flavour, and crossed it with a less efficient but better-smelling *saké* strain. By selecting progeny without the gene variants for the off-flavour, they obtained a new beer yeast that combines swift fermentation with a lovely, fruity aroma. And this could be just the beginning. The Belgian scientists expect a range of novel yeast hybrids to follow from their research; and this would have welcome scientific applications in the beer industry of a country renowned for the wide range of craft and industrial beers (*The Economist*, 2016b).

Regarding the role of yeast and the fermentations it generates, one may summarize it by saying that yeast is the basis of the three pillars of gastronomy: bread, cheese and wine. When fermentation is mastered by humans, it gives a more complex taste to the foodstuffs and it often preserves them for longer periods. The most well-known fermentation is alcoholic fermentation: yeasts transform the grapes' sugars into alcohol (ethanol) and carbone dioxide (CO_2). Some 17 g of sugar are needed to produce 1° (Gay-Lussac) of alcohol; but they also produce new aromatic compounds which give each wine a large part of its flavour. From the enologist's viewpoint, you just have to add yeast to grape juice in order to start the fermentation. From a poetic viewpoint, and the nature's lover, it is the bloom – a light white wax – that covers the skin of the grapes, which contains the best yeasts for the fermentation. But recent observations have shown that there are on the grapes minimal quantity of *Saccharomyces*-type yeast that cannot generate a spontaneous alcoholic fermentation. By contrast, there is much more of this yeast type in the wine storehouse and on the vine-handling equipment. The so-called "indigenous" yeasts imply a non-voluntary human intervention, while remaining part of the terroir (Neiman, 2019).

In the production of champagne and sparkling wines, there is a second fermentation, that is qualified, in order to avoid any confusion, as secondary champagne fermentation. Yeasts and sugar are added to a wine that is already bottled. Alcohol and CO_2 are produced, and these are at the origin of the future bubbles in the glass when the wine is uncorked. There is another less-known fermentation that plays an important role in wine quality: the malolactic fermentation. Malic acid, typically found in apples, is transformed by bacteria into lactic acid – which can be tasted in yogurt – that is sweeter and velvet-like. The malolactic fermentation has been discovered in the 1930s and mastered several years later. This fermentation is part of the production of red wines and some white wines. It is inhibited when the wine-maker wants to keep the vivacity of most claret wines (Neiman, 2019).

The creation of a beer behemoth: the megamerger of SAB Miller and ABInBev

After many battles behind the scene, the Brazilian giant beer-producer ABInBev was ready to purchase its closest rival, the SAB Miller group. The latter, listed in the London Exchange, announced in a press release of 13 October 2015, that he had accepted the last offer of ABInBev. The Brazilian group has made an offer to buy each share of SAB Miller for £44, meaning that the value of the latter was estimated at £71.2 billion or €96 billion. That was a bonus per share of almost 50% compared with the SAB Miller share value on 14 September 2015, just before ABInBev alluded to its first attempts to purchase its rival. The world's leading brewer, the headquarters of which are located in Leuven (Belgium), had until the 15th of October 2015 to conclude the deal. The pressure was strong on SAB Miller's shareholders. But ABInBev was determined to include the beer brands such as Coors, Foster's, Miller and Peroni, in its portfolio which already included the brands Stella Artois, Budweiser, Beck's or Corona. To that end, ABInBev did not hesitate to increase its offer in order to eliminate the shareholders' reluctance and to achieve that megamerger. Indeed, to convince SAB Miller's shareholders the chief executive officer (CEO) of ABInBev, the Brazilian Carlos Brito, alluded to the creation through the megamerger of "the first real global group of the beer industry." It is true that the new association would result in: out of three bottles of beer sold across the world, one was sold under one of the brands belonging to the new behemoth. The annual turnover of the latter would amount to US$64 billion or €56 billion, while the operating profit would be US$24 billion. This megamerger was another challenge for Jorge Paulo Lemann, Brazil's wealthiest man, which owns with two partners the giant ABInBev. He first bought the Brazilian beer brand Brahma and thereafter disbursed US$90 billion over ten years to build up ABInBev. He had to put an almost equal amount of money to build the world's biggest beer-industry group (Girard, 2015b).

ABInBev emphasized the geographic complementarily of both groups. The megamerger with SAB Miller aimed to be present on the markets of Latin America and Africa. SAB Miller had its roots in South Africa. At the end of the apartheid, the group decided to move to London and to become an international group, while purchasing the American beer brands, Miller and Foster's. But Africa was still the driving engine of its annual turnover. In the continent, beer consumption increases and this will compensate the erosion of beer sales in the United States and Europe. The Americans

tend to scorn Budweiser and are increasingly prefering craft beers. There is in fact a multiplication of craft breweries that produce small volumes, but are appreciated by the consumers because of their savours and flavours, and also their environment-friendness. In addition, SAB Miller, in association with the French company Castel, strengthened its position on the continent, through the fusion of its bottling activities with those of Coca-Cola. The opening up of the Latin American markets to the newly created group would benefit from the fact that an important shareholder of SAB Miller (14%) was the family of Alejandro Santo Domingo – one of Colombia's wealthiest businessmen (Girard, 2015b).

Worldwide production and consumption of wines

By the mid-2010s, the top ten wine-producing countries across the world were the following:

- France 46.7 million hectoliters
- Italy 44.7 " "
- Spain 38.2 " "
- United States 22.3 " "
- Argentina 15.2 " "
- Australia 12.0 " "
- South Africa 11.3 " "
- China 11.2 " "
- Chile 10.5 " "
- Germany 9.2 million hectoliters.

At that time, France was the world's leader in wine business: the first-biggest producer in terms of volume and the first exporter in terms of value – an estimated average revenue of €77 billion between 2000 and 2014. The annual turnover of French wine-making and sale-business has been estimated at €12 billion in 2013 (*Le Monde*, 2015).

The production of wines in terms of *bottles* was the following by the mid-2010s :

- France 6.19 billion bottles
- Spain 5.86 " "
- Italy 5.58 " "
- United States 4.86 " "
- Argentina 2.10 " "
- Australia 1.61 " "
- China 1.44 " "
- Chile 1.36 " "
- South Africa 1.22 " "
- Germany 1.20 " "
- Other countries 2.67 billion bottles.

Worldwide, a total of 34.09 billion bottles have been produced (*Le Monde*, 2015).

Regarding consumption, the United States was the world's biggest consumer of wines by the mid-2000s, *in terms of volume* :

- United States 4.08 billion bottles
- France 3.56 ¨ ¨
- Italy 3.46 ¨ ¨
- Germany 3.30 ¨ ¨
- China (including Hong Kong) 1.74 ¨ ¨
- United Kingdom 1.61 ¨ ¨
- Argentina 1.35 ¨ ¨
- Russia 1.09 ¨ ¨
- Spain 0.98 ¨ ¨
- Australia 0.69 billion bottles (*Le Monde*, 2015).

In France, the average annual consumption of wine per inhabitant has been estimated at 47.4 liters, followed by Italy (48.1 liters per inhabitant), and far ahead of the United States (13.4 liters per inhabitant) or China (1.4 liters per inhabitant). The United States spent more money in terms of consumption of wines, US$33.2 billion in 2018, compared with US$29.5 billion in 2014 and US$23.1 billion in 2009. In 2018, the average annual consumption of wines in the United States was estimated at 13.4 liters per inhabitant. Regarding China, the production in billion of bottles of wine was *ca*. 1.44 by mid-2010s, while its imports in million of bottles was estimated at 526.8 in 2018 compared with 154.8 million bottles in 2009, an increase of 165.6 % between 2009 and 2013. France is the main supplier of China: 174 million bottles of French wine in 2013, and 91.5% of the consumed non-sparkling wines were red wines (*Le Monde*, 2015).

By the mid-2010s, the world's biggest exporters of wines were: Italy with 2.06 billion bottles, France with 1.81 billion bottles and Spain with 1.36 billion bottles. As mentioned above France remains the world's biggest exporter of wines in terms of value and not in volumes. In this case, it ranks behind both Spain and Italy (*Le Monde*, 2015). But this picture changes from one year to another: in 2018, Italy became the world's leader (production), followed by Spain and France (see p. 371). In terms of quality, the French wine harvest includes 28.1% of wines with protected geographic indications, 46.6% of wines with controlled or protected appellations (AOC/AOP, French acronyms), 16.6 % of wines transformed into spirits (*eau de vie*) and 8.7% for other uses. These figures are annual averages over the period 2004-2013. The main French vineyards are located in the following regions: Languedoc-Roussillon (acreage *ca*. 226.000 ha, volume, 1,680 million bottles and annual turnover, €2.2 billion); Bordeaux (*ca*. 112,000 ha, 720 million bottles and €3.74 billion); Loire (*ca*. 65,000 ha, 380 million bottles and €1.5 billion); Rhone Valley (*ca*. 70,000 ha, 376 million bottles and €1.47 billion); Champagne (*ca*. 33,705 ha, 307 million bottles and €4.5 billion); Alsace (*ca*. 15,000 ha, 150 million bottles and €500 million). The values indicated in euros are those of the average annual turnover of the wine business in the regions listed. Furthermore, more than 8 million tourists have visited the French vineyards and

this 2010 figure is increasing; it has been calculated that the average amount of money spent by each tourist visiting or staying in the vineyards was €203. These visitors come from France itself (61%), Belgium (10%), United Kingdom (10%), Netherlands (4%), Germany (3.5%), Switzerland (2.5%), United States (2.5%), Italy (1.5%) and Spain (*ca*. 1%) [*Le Monde*, 2015].

Are we growing the same grape varieties as in the Middle Ages or even earlier?

The Eurasian grapevine (*Vitis vinifera*) has long been important for wine production as well as being a food source. Despite being clonally propagated, modern cultivars exhibit great morphological and genetic diversity, with thousands of varieties described in historic and contemporaneous records. Through historical accounts, some varieties can be traced to the Middle Ages, but the genetic relationships between ancient and modern vines remain unknown. Ramos-Madrigal et al. (2019) of the Natural History Museum of Denmark have presented target-enriched genome-wide sequencing data from 28 archaeological grape seeds dating to the Iron Age, Roman and medieval period. When compared with domesticated and wild accessions, the researchers found that the archaeological samples were closely related to western European cultivars used for wine-making today. They identified seeds with identical genetic signatures present at different Roman sites, as well as seeds sharing parent-offspring relationships with varieties grown today.

According to Ramos-Madrigal et al. (2019), varieties like pinot noir or syrah have been very slightly modified since the Roman era. And one seed dated to ~1100 CE was a genetic match to "Savagnin blanc", a white wine variety nowadays grown in the French Jura region; the seed, identified by the Danish researchers in the city of Orléans (centrewest of France), provided evidence for 900 years of uninterrupted vegetative propagation of the grapevine variety. Two thousand years ago, during the first century of our era, Pline The Senior, a famous Roman historian and also a natural scientist, was very impressed by the wide range of wines and grapes existing in the south of France; this region had, according to him, a great technical knowledge in the propagation of the grapevine varieties through cuttings and there were at that time 90 distinct cultivars. In order to shed a new light on how old are the present common grapevine varieties, the Danish team of researchers sampled 28 pips in nine archaeological sites across the French territory. The DNA of these pips was sequenced and compared with the sequences belonging to a genetic-resource database of the National Agricultural Research Institute (INRA). This database contains the genetic data of at least 900 grapevine varieties cultivated presently. "These ancient grapevine varieties resemble very much those cultivated nowadays in western Europe; they existed before the implantation of the first vineyards in France in the 6th century BC and during the Roman era. The wine-growers knew very well the techniques of cuttings and grafting that were necessary for their conservation and dissemination over at least 600 km distances," explained Roberto Bacilieri, a research engineer at the INRA of Montpellier (southeast of France). This means that these wine-growers of the past have been able to transmit those grape varieties through cuttings. They also probably relied on crossings, made once or twice over one or two millennia (Minassian, 2019).

French vineyards: strengths and weaknesses

In 2016, a rainy spring season and little sunshine, intense frost spells, hail and drought had a negative impact on wine production in France: -12%, down to 41.9 million hectolitres. But despite this bad weather, France kept its rank of second producer of wine in the world, according to the figures published on 20 October 2016 by the International Grapevine and Wine Association (OIV, French acronym for *Organisation internationale de la vigne et du vin*). Italy was still the world's leading producer, with a production of 48.8 million hectolitres (-2.2% compared with one year earlier). Spain was also still the world's third-biggest wine producer: 37.8 million hectolitres (+1% compared with one year earlier). Argentina also lost 35% of its harvest due to erratic weather phenomena: down to 8.8 million hectolitres. Chile was in a similar situation, with a 21% decrease in its wine production, down to 10 million hectolitres. Consequently, in 2016, the global production of wine was expected to be reduced by 5% down to 259 million hectolitres, one of the lowest levels in 20 years. Nevertheless, the volumes of wine stored in the wineries were higher than those of global consumption (Girard, 2016).

A contrasted situation

The overall 12% decrease in French wine production in 2016 should be put in the context of various situations, from a wine-making region to another. For instance, "Champagne with an expected harvest (in 2016) of 1.7 million hectolitres (-32% compared with one year earlier) and the Charente region with a harvest of 7.4 million hectolitres (-22%) were the most affected regions," explained Baptiste Montange of the public institute France-Agrimer. It should be, however, mentioned that the grapes harvested in Charente are, to a large extent, expected to be distilled and transformed into Cognac. The resulting blended *eau-de-vie* is stored in wooden barrels where it matures for years. The resulting stocks enable the cognac-makers to withstand erratic weather phenomena. Regarding Champagne, there has been for a long time a very experienced interprofessional organization. "The bottles of champagne remain in the wine cellars for three, four or even seven years. Therefore there are important stocks of wine," explained Maxime Toubart, president of the General Trade Union of Champagne Wine-Makers. "At the beginning of each year we determine a maximum yield and a volume which every wine-maker can draw from his or her stocks; this volume depends on the foreseen sales in the medium term,"he added. In 2016, the yield has been fixed at 9,700 kg per hectare, with the possibility to release 1,100 kg per hectare from the stocks, but "the wine-makers whose yields have been affected by the weather could release an additional volume in order to reach the equivalent of 9,700 kg per hectare," underlined M. Toubart (Girard, 2016).

By contrast, other regions were in better shape: for instance, the harvest increased by 6% in the region of Bordeaux, reaching 6 million hectolitres, and a similar situation was recorded in Alsace. However, the situation did not seem satisfactory in the Languedoc-Roussillon region, which supplies the largest volumes of wine at the national level; a 10% decrease in production has been observed in the Bourgogne vineyards, whose potential had been drastically hindered – more than 20% – by hail storms and frost. Also the vineyards of the *Val de Loire* (Loire Valley) have suffered in

the same way. The sales of French wines and the revenue provided for the country's balance of trade had a fair growth: during the first half of 2016, the sales increased 1%, up to €5.3 billion, thanks to those of cognac and champagne (Girard, 2016).

French vineyards under the threat of withering diseases

Grapevine growers and wine-makers have been struggling for several years against the withering of their vines, that affected 15% to 20% of the French vineyards and which hit the vineyards in other wine-producing countries. This withering is caused by the diseases of the wood, of which the main ones in France are: the so-called "esca," "the most serious disease due to several fungi," explained the French National Agricultural Research Institute (INRA); the euphytosis caused by the fungus *Eutypa lata*; and the withering caused by fungi belonging to the *Botryosphaeria* group and found in many vineyards of the Unites States, South America, Europe, Australia, Lebanon and South Africa. These parasitic fungi have been identified for the first time, around 2006, in the Touraine and Jura vineyards, before commonly found in all the wine-producing regions (Barroux, 2018a).

These distinct diseases, some of them have been known for centuries, consist of wood necrosis and the presence of a "white rot." One can observe on the leaves several changes in colour, witherings and vascular disorders. The withering of a grapevine stem can be slow or "apoplectic", i.e. the grapevine can die after a few days. In some vineyards, it is not rare that 50% of a plot can be affected by esca. "Withering of the grapevines is violent, it could be compared with the phylloxera crisis of the 19th century. In some vineyards and wineries the end result of the disease is a 5% decrease in the annual yield, one year after the other. Which means that in ten years half of the total production would have disappeared," explained Jean-Martin Dutour, president of the Interprofessional Association of the Wines from the Loire Valley and also a vine-grower and trader at Chinon (department of Indre-et-Loire, centrewest of France). One way of controlling the withering diseases is the regrafting technique – a delicate procedure that needs a good training. It is not costly and even though it is time-consuming, it is more efficient than replacing the dead plants by new ones. The new scion uses the root network already installed in depth of the stock, its growth does not compete with older and nearby plants. "The return of the regrafted plot to full production takes two years instead of seven to nine years," and the cost of this technique is between €2 and €3 per plant instead of almost €10 if the grapevine is replaced by a new one (Barroux, 20108a).

The wide spreading of the diseases led the chambers of agriculture to set up training and information programmes as well as exchanges of good practices. "Growing grapevines organically does not change anything to the withering of vines, because it is a multifactorial phenomenon. Its origins can be the terroir, the stock, the plant and the pruning process. Almost 70 causal factors have been identified: bacteria, fungi, weather stress and horticultural practices. And as there is not a single cause, there is not a single solution," explained Boris Desbourdes, who owns a 15-hectare vineyard planted with the Cabernet franc variety and one-hectare plot planted with the chenin variety – a white wine, bearing the "Chinon appellation". The studies carried out in

all the wine-producing regions have led to the same conclusions: these diseases are spreading in conjunction with climatic factors – rainfall does have an impact on wetting the wood and on its greater susceptibility to the development of fungi, whereas water stress and drought weaken the whole plant –, as well as in the connection between disease susceptibility of grapevine varieties and horticultural practices. In the latter case, "wounds, made by a very strong pruning that could mutilate the tree, would be a natural entry of the esca. Therefore, more attention should be paid to a careful and less traumatizing pruning, as well as to the relevant training of permanent staff and seasonal workers," added B. Desbourdes. Also, all the wine-makers mentioned a decisive factor: in 2001 the prohibition of sodium arsenite – this bioactive substance is considered carcinogenic – by the agriculture ministry with a view to protecting wine-growers and workers' health. But such prohibition resulted in the non-use of the only reliable tool against these wood diseases. "Until 2001, sodium arsenite could be used to slow down the spreading of the disease. It was right to prohibit its use, but there is no substitute. The grapevines that were planted in the 1970s suffered losses that were acceptable. But at the beginning of the 2000s, the disease has expanded and the losses could reach up to 10%, i.e. one plant out of ten, which is considerable," explained Bernard Artigue, president of the Gironde chamber of agriculture (Barroux, 2018a).

The estimated loss in terms of value could reach up to €1 billion per annum for all the vineyards; this loss amounted to 10% of the global revenue. The wine-growers and makers have therefore designed a National Plan regarding vineyard withering, and five new programmes have been launched in June 2018 by the agriculture ministry, France Agri-Mer and the National Committee of Wine Interprofessions. A total of €10.4 million should be invested in this plan between 2017 and 2022. Topics to be investigated include: plant and soil interactions; socio-economic measures needed to change the horticultural practices; and knowledge and know-how transfer (Barroux, 2018a).

Challenges of the wine industry

In 2018, the French wine industry was valued at €14.5 billion, i.e. one-fifth of total agricultural production. Furthermore, the exports of wines and spirits reached a record level: €13.1 billion. These figures testify of the good health of the French wine industry. And, by contrast to other agricultural professions, wine-makers who are numerous across the French territory can live from their work. It is difficult to predict what would happen in the near future because the sector is vulnerable; at the same time, it is coveted and generates a number of opportunistic actions. Consequently, the whole world of grapevine-growers and wine-makers is facing several challenges. The first one concerns the expansion of the vineyard area. The European Commission, with its liberalization approach, foresaw the elimination of plantation rights on the 1st of January 2016. However, the Commission decided to postpone such a decision and set up at this date a system of plantation authorizations. In other words, this approach predicted a potential growth of the vineyard area in each Member State, limited to 1% per year. In the case of the French vineyards, there was, *a priori*, the possibility to plant grapevines across the whole territory. During the first year of application of

the system, in 2016, 3,590 hectares of grapevine plantations were allocated; 4,700 ha in 2017; and 5,700 ha in 2018. This was below the global 1% authorized. In 2019, each French vineyard proposed a plantation quota. The Cognac vineyard requested an acreage much larger than those of the Gironde and Burgundy regions. It is true that the international success of the Cognac companies, supported by such big groups as Louis Vuitton, Moët and Hennessy (LVMH), Pernod Ricard and Remy Cointreau, leads them to increase their production capacities. The Cognac region wished to request a similar surface increase in 2020 and 2021. However, the other wine-making regions of France were concerned about a possible reversal of Cognac sales that might cause a surplus of non-distilled white wine, and subsequently upset the French market. But in 2019 the Cognac region won the game (Girard, 2019).

A second challenge is the limitation of production of wines without appellation in the wine-producing regions. The regions of Champagne, Burgundy and Alsace, claiming that they might suffer if their fame were encroached upon, have requested a limitation to 0.1 hectare. That was respected by the agriculture ministry. But finally Champagne has fixed its limitation to 2 ha, Burgundy to 25 ha, while Alsace maintained its limitation to 0.1 ha. On 28 February 2019, the government examined the amended versions of the regions' requests and indicated that it will be able to allocate a maximum of 8,109 hectares in 2019, bearing in mind that the French vineyard has a total acreage of 810,000 hectares. Therefore, each region could make its request for plantation (Barroux, 2018c).

Regarding the wines without appellation, there are two distinct approaches by the wine-makers, on the one hand, and the traders and wine-and-spirit companies on the other. The former are very supportive of the appellations of controlled origin (AOC, French acronym) or protected geographic indication (IGP, French acronym), that are the basis of the fame and value of French wines. The latter are more attracted by the industrialization of the sector and would like to see the emergence of a smaller number of big groups that would help promote renowned brands. The supporters for French wines without geographic indication are swiftly moving, taking advantage of the new regulation. Those who requested the plantation authorizations by the European Commission, had proposed to open the French wine market in 2018, and had attacked the restrictions imposed by the Champagne region. Regarding this debate within the European Commission, France has been supporting the extension of the present authorization system until 2050, instead of 2030 (Girard, 2019d).

A third challenge concerns the total or partial replacement of such grapevine varieties as gamay, chardonnay or merlot, with new hybrid varieties whose names remain to be invented. "These hybrid varieties, named resistant, must comply with several regulations: they should respond to environmental and societal stakes regarding the limitation of agricultural inputs, respond to climate warming and to the phytosanitary conditions of the grapevine," explained Christian Paly, president of the AOC Committee of the French National Institute for the Wine Origin and Quality. Nowadays, the hybrid varieties authorized is Europe are the result of crossings between the European grapevine, *Vitis vinifera*, and American or Asian varieties. The use of those hybrid varieties will entail the payment of royalties by the wine-makers – an unprecedented

event in France. There are strong opponents of the use of hybrid varieties, claiming that they are a threat to the French wine heritage. Meanwhile, the European Commission has suggested to use some hybrid varieties, for instance those created through the crossings with American varieties, e.g. the *noah* of which one of the genitors is *Vitis labrusca*. Introduced into France after the phylloxera epidemic wreaked havoc upon the French vineyards at the end of the 19th century, they were later on abandoned and superseded by grafted grapevines. This grafting aimed to protect the genetic heritage of European grapes (Girard, 2019d).

Champagne: a wine of exception and a flagship of wine sales

In 2017, champagne cultivation reached an acreage of 33,870 hectares; it has been steadily growing from 10.000 hectares in 1919. This acreage amounted to 4% of total grapevine acreage, while it has been estimated that across the world this acreage was about 0.4%. In 2017, in terms of annual turnover, champagne production amounted to 20% of the whole French vine-growing and manufacturing-enterprises. In 2017, 307.3 million bottles of champagne have been sold for €4.9 billion. Theses sales were distributed as follows: 50% on the French market, 20% in the European Union and 25% in the rest of the world. In 2017, in million euros, the five biggest foreign markets of French champagne were: United States (€586 million), United Kingdom (415), Japan (307), Germany (197) and Italy (152). In terms of employment, 30,000 direct jobs and 120,000 seasonal jobs are involved in champagne production (Barroux, 2018c).

In 2018, champagne production, in terms of volume and quality, was considered an exceptional vintage – an event that had not happened for a long time. This very favourable situation was also true in most grapevine-growing and wine-making regions of France. The following figures show the abundance of the harvest: 10,800 kg of grapes per hectare, i.e. the authorized yield achieved in 2015 has been reached everywhere. As the vintage was an exceptional one, the French National Institute for the Wine Origin and Quality has decided to raise the volume of grapes allocated to reserve wines, from 3,200 kg per hectare up to 4,700 kg per hectare. Thus the wine-makers could boost their reserve and modify it, i.e. replace 2017 wines of lesser quality with 2018 wines of much better quality. It should be recalled that the reserve regarding champagne means "frozen" wines, i.e. a buffer aimed to mitigate weather vagaries. For instance, in 1978, the harvest was 3,700 kg of grapes per hectare, i.e. three times less than in 2018; the reserve served therefore as a regulating factor, thus avoiding the recurrent drawbacks of overproduction or shortage. These "frozen" wines can be stored up to 8,000 kg of grapes per hectare, all years held concurrently, and no commercial operation is authorized; the reserve is individual and works like a personal insurance. These "frozen" wines must be stored in vats; bottling is prohibited, either at the wine-making place, at the cooperative of wine-makers or at the trade companies (Barroux, 2018c).

Why the year 2018 has been an excellent year? Weather conditions were good throughout the whole region of champagne production – except a spell of hail at the end of April and during the following month, which spread some fear among the grapevine-growers; autumn and winter have been rainy, spring was dry and summer

with enough sunshine. The harvest started on 20 August and 2 September 2018. It was the fifth time in 15 years that the harvest started in August. In terms of sales, the champagne-exporters' sales reached €1.6 billion in the United States. If Cognac and other spirits were added, the figure amounted to €3.2 billion, a 4,6% increase compared with 2017. Therefore, the United States continued to be the first destination of French wines, including champagne and spirits (Barroux, 2018c).

Regarding 2019, the agriculture ministry made some forecasts on 20 July 2019. It has estimated that the overall harvest would be lower than that of 2018; the decrease was estimated at between 6% and 13%, the volume foreseen was between 42.8 and 46.4 million hectoliters. Once again weather vagaries explained this backstep: rainfall and frost during the flowering of the grapevine, i.e. in the spring, have curtailed the potential harvest of several producing regions; furthermore, the very hot period in June 2019 has burnt the grapes in the south of the country. However, the data published on 12 February 2020 by the French Federation of Wine & Spirits Exporters (FEVS, French acronym) showed that 2019 was a record year: the annual turnover of national wines and spirits production and businesses soared to €14 billion (+5.9% compared with 2018). The exports of the same items rose to an estimated €12.7 billion (+8.5% compared with 2018), and a total of 195 million crates of wines and spirits have been exported in 2019. Champagne exports enjoyed a 7.5% growth rate in 2019 and reached a value of €3.1 billion, while during the same year Cognac sales recorded an export-turnover of €3.48 billion (+11% compared with 2018). Cognac exports made up three-fourths of French spirits sold abroad. Once again, in 2019, the United States purchased *ca*. €1.88 billion of French spirits (+21.8% compared with 2018). The United States also remained a major market for champagne and the value of its imports also increased in 2019. Despite these very good results, the French grapevine-growers and wine-making businesses expressed their deep anxiety to the national authorities, due to the very uncertain immediate future of their professions. In fact, they were scared of the threat held up by Donald Trump, President of the United States, who wanted to impose a 25% tax on French wine imports. Even though sparkling wines were not expected to be taxed, such a measure would make the French wines too expensive compared with other provenances. And in fact, in December 2019, still-wine exports have dropped by 50%. The FEVS vice-president was foreseeing a 20% to 25% drop in the annual turnover of the whole wine business in 2020 – and even 40% in the worst case (Girard, 2019k, 2020a).

Champagne vineyards: hundreds of terroirs and a geographic mosaic of vintages

The Champagne area (centre-east of France) includes hundreds of very distinct terroirs. The region includes 319 vintages distributed in five departments: 60% in the Marne department, 23% in Aube, 10% in Aisne, and the rest in the department of Haute-Marne and Seine-et-Marne. We are dealing with 34,000 hectares of vineyards, which 15,800 vine-growers are taking care of. In 2020, the appellation champagne applied to 30,000 hectares, compared with 10,500 hectares in 1950. Since 1927, a law has determined the grape varieties that should be blended to make champagne, as well as their respective proportions: pinot-noir (*ca*. 38% of the area in 2016), pinot-meunier (*ca*. 31%) – almost the total acreage of this variety is found in Champagne – and chardonnay (*ca*. 30%). Four other varieties grown on less than 0.3% of the whole

acreage were also included in champagne blending. The Champagne region consists of *ca*. 278,000 plots, the average acreage of which is 1,200 m^2. It is within this geologic and climatic patchwork and on the hills, often steep and topped with forests, that the famous wine is produced. The cities of Reims and Epernay may be called, each, the capital of champagne, although officially there is no rivalry between them. In Epernay is headquartered the Interprofessional Committee of the Champagne Wine. Also in Epernay is located the renowned trade company Moët and Chandon; there are about 110 km of cellars and a champagne avenue, where are the seats of the big trade corporations. This ensemble is part of the UNESCO World's Cultural Heritage List. Compared with Epernay – a city of 24.000 inhabitants – Reims (190,000 inhabitants) is the 12th city of France in terms of population, and it is planning to become a "city of champagne"; like this was done in Bordeaux for wines. Reims, with four sites on the UNESCO's World's Cultural Heritage List, is the city where the Kings of France used to be crowned. But both cities can rightly claim to be the headquarters of champagne-trade companies: Taittinger, Mumm, Lanson, Ruinard, Pommery, etc., in Reims; Moët and Chandon, Pol Roger, Perrier-Jouët, de Venoge, Mercier, etc., in Epernay. The biggest champagne cooperative, Nicolas Feuillatte, is located a few kilometers from Epernay. Also renowned brands of champagne are found outside Reims and Epernay, e.g. Bollinger in Aÿ, Drappier in Hautvillers, Joseph Perrier in Châlons-en-Champagne. According to Arnaud Robinet, the mayor of Reims at that time, "the true capital of the Champagne region would be Aÿ or Hautvillers, where the famous wine was born" (Barroux, 2018d).

In 2015, when the UNESCO decided to put on the World's Cultural Heritage List "the hills, houses of wine-making and trade companies as well as the cellars of Champagne, it wanted to underline the peculiarity of this region, but also its unique know-how and diversity," explained Thibaut Le Mailloux, communication director of the Interprosessional Committee of the Champagne Wine. This paradox between uniqueness and diversity is not always easy to understand. A wine connaisseur can, for instance, distinguish the varieties of wines produced in the Rhone Valley or Burgundy. In the case of champagne, the choice will be made between a Taittinger, a Mumm, a Bollinger or a Moët and Chandon, or between a champagne produced and marketed by a "big" trade company and a wine made by a small wine-maker. But the terroir is not the only distinctive feature; big brands and companies must also give their footprint and their style, that will enable them to be distinguished by the wine connaisseurs. Damien Le Sueur, the CEO of Taittinger champagnes, explained: "A house (company) of champagne has its own wine signature and it will seek, across all the terroirs, what will help write its own history. There is a range of colours, which are associated with the terroirs, but it is the mixing and blending of their wines, made by the chief of the cellar, which gives the final touch of wine identity." For instance, the Reims-based Taittinger claims that it has a chardonnay identity (Barroux, 2018d).

Regarding the geological and soil characteristics of the terroirs existing in the Champagne region, the bedrock under vineyards, planted at an altitude of 90 m to 300 m, is to a large part chalky (limestone). There are nevertheless many geological differences. For instance, near the Reims Mountain, the underground is often made of clay or sand. The wine-maker's art or that of the cellar's chief will consist of blending

the properties of each terroir, of each grapevine variety, while bearing in mind the weather conditions prevailing during the year. This blending must rely on the features of the three main grape varieties that make up the champagne: pinot-noir gives the strength and structure; chardonnay is the basis of floral aromas and minerality; and pinot-meunier gives the fruity and smoothness characteristics. But each grape variety will have different aromas depending on its original plot; consequently, blending results in a wide range of wines (Barroux, 2018d).

Regarding public perception, for 28% of the tourists visiting the Champagne region the main attraction is the wine. According to a poll made by Opinion Way, from 19 to 28 January 2016 and targeting French, British, Belgian, Chinese and Japanese people, already settled in France or who would like to do so, 48% wished to stroll around the vineyards and drive along the Champagne roads; 35% wished to sip and taste the wine, while 29% wanted to visit the cities and their monuments. It is the general opinion of the wine-growers and makers that the image of champagne should be changed so as to become appealing to young people. It must therefore be a wine that can be drunk, with moderation of course, any day and become a wine adapted to modern life. What is therefore the best way to drink champagne? The champagne flute was designed by English people around 1750. Due to its reduced diameter, the contact surface between the wine and the air is not large and this limits the loss of bubbles. The length of the stem of the flute enables the drinker to maintain the champagne far from the hand and therefore to keep it cold. The problem raised by the flute is that the longer it is, the longer is the time for the bubbles to reach the liquid surface. The flute is often filled too much, which inhibits the full perception of aromas. At the end of the 19th century, the flute was not so popular among French people, but it has made a comeback into their heart since the 1930s. The cup was the gentry's response to the aristocracy's flute. It is less fragile than the flute and it can be filled up. But regarding the tasting of the champagne, it has all the drawbacks: it is so tapered that all aromas are dissipated and carbon dioxide is rapidly evacuated. Consequently, the cup rapidly deprives the champagne of its effervescence and taste. The cup is nevertheless used as a common name: someone often says "I take a cup of champagne, even though he/she will have a flute in his or her hand". At the end of the game, it is the wine glass which is preferred by the connaisseurs and tasters of champagne. This trend has started a dozen years ago. But now, based on the experiments made at the University of Reims Champagne-Ardennes, the preference goes to the long and potbellied wine glass with a reduced diameter for its opening. It is important for the wine-maker or the drinker to dive the nose in order to capture all the champagne aromas. Because the champagne remains a wine, it must be tasted as follows: the wine is poured to reach only one-fourth of the height of the glass; regarding the bubbles, they are not too big, nor quickly evacuated, just perfect (Barroux, 2018c).

Impact of the Covid-19 pandemic

According to a poll carried-out by *Santé publique France* (Public Health France), an agency of the French health ministry, and the results of which were published on 13 May 2020 – the poll was carried out between 30 March and 1 April 2020 among 2,003 participants – 11% of polled persons stated that they drank more, and more

than 24% drank less during the period of lockdown imposed on the population to slow down the propagation of the Covid-19 pandemic (see pp. 21-33 and Epilogue). But what was striking is the collapse of sales of bottles of wine, "around 40% to 50% at least", stated on 15 May 2020 the organization *Vin et société* (Wine and Society). They are several reasons for what happened: closing-down of bars, cafés and restaurants, and of some cellar shops; abrupt interruption of exports (40% for some vineyards or even more); reduction in convivial meals; interruption of the business relating to the organization of all kinds of events. Moreover, the first priority for the French people during the lockdown was the purchase of food (Barroux et al., 2020).

All vineyards have suffered as well as the purchase areas. But not necessarily with the same intensity. For instance, the sales in hyper/supermarkets, where most of the consumption takes place, have receded by up to 10%, while the sales in neighbourhood (vicinity) shops rose more than 15%. Regarding the *e*-commerce, it soared by a record 73%. One has nevertheless to bear in mind that the average cost of the purchased bottles has markedly decreased: during that pandemic period, the lesser the cost of the bottles, the higher number was their purchase. It should be emphasized that during the pandemic the weather was fine over almost all French vineyards: grape-growers could work on their vines at leisure. Whereas the wine-producers had to face a major decrease in their turnover. The total bill was expected to be heavy for a country whose vineyard acreage amounted to *ca*. 810,000 hectares and where grape cultivation and wine production employed 500,000 persons in 2019. The contribution of the exports of wines and spirits to the country's trade balance ranked second just after aeronautics. When the vineyards-owners had sufficient funds, they can store the expensive bottles and wait for better times. Otherwise, most of the bottles are sold and drunk during the following year (or two) of their production. Consequently, if the consumption is abruptly interrupted, wine-makers and businessmen find themselves with hundreds of unsold crates. The overall conclusion is clearcut: the most vulnerable businesses will go bankrupt. It has been estimated that the decrease in wine consumption in France reached -50%, due to the closing-down of cafés and restaurants, the interruption of tourism for at least two months and also due to the taxes imposed by the United States' administration on the imports of French wines since October 2019 (Barroux et al., 2020).

The region around the city of Bordeaux (centrewest of the country), that is generally weakened in normal conditions as a result of overproduction, suffered from the pandemic: even the well-known vintages have been hit. While the exports of these high-end wines often represent more than 50% of the annual turnover of some wine-makers and businesses, the heavy harm was due to the fact that three main clients – United States, China and United Kingdom – were also seriously affected by the pandemic. Furthermore, the great-vintage owners had to cancel their main and profitable annual meeting, that is the early tasting of their 2019 wines. This meeting was expected to take place between 30 March and 3 April 2020 and to be attended by 5,000 to 7,000 importers, distributors and wine critics, half of them being foreigners. This annual meeting was not just a gala event, it aims to fix the prices for each kind of wine and to give many opportunities to fill orders for the year. In other words, the market value of the Bordelais – the wine-producing region of Bordeaux – is at stake when

these new wines are presented, tasted and ordered. Because of the pandemic, a radical decision was made: instead of welcoming the usual attendants of the 2020 meeting, the new wines will be dispatched to their customers for tasting. Consequently, tasting was scheduled, in June and July, in a dozen of cities including Bordeaux, Singapore, London, San Francisco, Shanghai and Zurich (Barroux et al., 2020).

In the Champagne region, the implications of the pandemic were even worse. Even those wine-makers who have stayed opened during the lockdown period, the sales fell off : -60% in two months. Vitalie Taittinger, which owns the famous company Taittinger, announced a 95% decrease in the annual turnover during the month of April 2020. "Nothing is being exported, with the exception of Japan, Sweden and Denmark. A 20% to 30% loss in champagne sales was foreseen during an unknown duration," she explained. In the Champagne region, grape harvests which are the core of the system, are more costly than elsewhere. It is in fact forbidden to use harvesting machinery in the grapevine rows and at least 120,000 persons have to be recruited by the end of the summer to participate in the harvests. Nicolas Feuillatte's cooperative director-general, Christophe Juarez explained: "Due to good weather, we shall start the harvesting in August. How to involve so many people taking account of "the sanitary measures is unprecedented" Some renowned brands have thought of a radical alternative: make the sacrifice of the 2020 harvest and, instead, use the vast volumes of grape juice they generally store during a good year – for instance in 2019. But this would be a disaster for those grapevine-growers who sell their harvest to these renowned brands. "I cannot sleep. There are 16,000 grapevine-growers in the Champagne region. My goal is to save the maximum of enterprises," stated Maxime Toubart, the chairperson of the General Trade Union of Champagne grapevine-growers. He was confronted with the dilemma: "Not harvesting too much grapes, and save as many grapevine-growers as possible from bankruptcy" (Barroux et al., 2020).

The Provence region (southeast of France) was perhaps less on a tight rope, but there is nevertheless an issue: during the summer – a crucial two-months period for the sales of the claret or rosé wine – the sales will depend on the opening of restaurants and the growth rate of tourism. These factors are "essential for our rescue," said Brice Eymard, director-general of the Interprofessional Council for Provence Wines. In fact, across the whole country, grapewine-growers and wine-makers have to set up new relationships with their customers. This is true for the vineyards who sell their produce to the large food-and-beverage distributors, but for the more vulnerable enterprises it is a real issue. A local wine cooperative in the southeast of France has suggested to independent wine-makers to sell their bottles in its premises. All these new initiatives had to be launched when the wine business should increasingly comply with ecological and sanitary standards, that are shared by the consumers. For instance, circular economy had been growing during the Covid-19 pandemic. It is expected that this trend will continue, while some experts and wine-makers claimed they were more concerned about climate-change implications than about the impact of the pandemic. It is worth mentioning that despite this negative impact, France remained the world's second-biggest wine producer, behind Italy in terms of volumes. France kept its rank of first exporter in terms of value (in 2019, *ca*. €12.7 billion has been earned from the sales of wines and spirits).

Organic wines

At the global level and in terms of sales, Germany, France and the United Kingdom represented in 2018, 23.9%, 16.4% and 10.2%, respectively, of the market of organic wines. They were followed by the United States (7.9%), Sweden (7.4%), Japan (6%), Austria (3.4%), Italy (2.4%), Spain (2.2%), Hungary (2%), and 18.2% for the rest of the countries producing and selling this kind of wines. In France, in terms of volumes, the sales of organic wines have doubled since 2012 and they were expected to double again in 2022. The number of bottles sold increased from 55 millions in 2012 to 112 millions in 2017, and probably 207 millions in 2022. The proportion of organic wine consumed was nevertheless very small: 3.72% of total wine consumption in 2017 and 7.68% expected in 2022. Between 2012 and 2017, the average annual growth rate of organic-wine sales has been +16.8%. Yet, in France the consumption of organic wine increases when the total wine consumption recedes: in 2012, out of the 3.3 billion bottles of wine sold, 55 millions were organic, and in 2017 out of the 3 billion bottles sold, 112 million bottles were organic; in 2022, the forecast was: out of the 2.7 billion bottles sold, 207 million bottles will be organic. Between 2012 and 2022, the reduction in total wine consumption has been estimated at -18% (Gasparotto and Neiman, 2019).

Situation in France

Organic farming amounts to only 10% of the total French vineyard acreage. At the beginning of 2019, there was not yet a 100% organic appellation. To reach that objective, all wine-makers and vineyards should comply with the norms of organic farming. For instance, in 2019, the area of Baux-de-Provence, with 11 wine-makers, has almost reached that stage: 10 vineyards have been certified as practising organic farming or biodynamic vine-growing and wine-making, and their acreage amounted to 85% of the total 243 hectares of vineyards. But the conversion to organic grape vine-growing is not an easy one. For instance, a region with a lot of sunshine, a dry climate and subject to strong wind, will be less prone to the fungal attacks of brown rot and oidium; consequently, the phytosanitary treatments (fungicides) are less frequent in the south of France (Provence), in the south of the Rhone region, the Languedoc-Roussillon (southwest of France) and even in Alsace, which enjoys a continental and rather dry climate. Conversely, in the region of Bordeaux (centrewest of the country) with an oceanic and humid climate, like in the Champagne region, more phytosanitary treatments are needed, and therefore organic vineyards are less numerous than in the former regions. In the region of Bordeaux (Bordelais), organic farming is carried out in 8% of the total acreage of vineyards, compared with 30% in the south of Corsica or 16.5% in the Haut-Rhin (Higher Rhine) region (Gasparotto and Neiman, 2019).

For those who cannot practise organic farming, they do their best to limit the use of chemical inputs and, nevertheless, safeguard a good harvest as well as an economic profit. This is “rational” agriculture and not organic farming; although it has been regulated in 2004, it was abandoned in 2007, when it was decided by the French government and its professional partners to set up three levels of environmental certification, the highest being the label of High Environmental Value (HVE, French

acronym). However, among the vine-growers and wine-makers the phrase "rational agriculture" is still used as an evidence of goodwill of those who cannot yet carry out organic farming. Why is it so difficult to be certified organic? Because a certified wine should comply with the regulations of organic farming as well as with those of organic wine-making, that have existed since 2012. The vineyards must be cultivated through organic farming for three years before obtaining their certification. Herbicides, pesticides as well as chemical fertilizers are banned, while phytosanitary products such as sulfur and copper are authorized. In order to make sure that these good practices are implemented, wine-producers are monitored by a duly authorized body, such as the widely known Ecocert. Regarding the use of copper to combat brown rot and oidium, the European Union has decided in November 2018 to reduce, as of 1 February 2019, the authorized concentrations: from 6 kg per hectare and per year over five years to 4 kg per hectare and per year oven seven years. It would be therefore possible to spray more copper if a harvest is under threat, and to probably spray less during the following year. Copper is toxic for the soil at high concentrations. It is a key product for organic wine-producers, because it is the only way to control grape brown rot (Gasparotto and Neiman, 2019).

Why some grapevine-growers and wine-makers try to go beyond organic viticulture? To that end, they practice biodynamic viticulture, which is another vision for producing wine, in connection with a cosmogonic view of agriculture. However in order to obtain the label of Demeter which certifies this practice, the wine must already have the organic label. With 450 hectares of biodynamic viticulture in the Rhone Valley, Michel Chapoutier explained his approach: "Let us compare viticulture with medicine. If I have a headache, I take aspirin. I therefore cure the symptom but not the disease itself. But I can drink an infusion. In this case, we move from the common behaviour based on the use of a synthetic chemical to an organic approach because we use a natural plant substance. But in both cases, we are not curing the problem; organic farming just replaces a synthetic chemical by a more natural product. We need to go further. As far as I am concerned, I ask myself the question: if the plant is diseased, what kind of disbalance affects it?" This biodynamic viticulture remains controversial. However, among the biodynamic vineyards, we find very famous wines, e.g. Roederer in the Champagne area, Château Pontet-Canet in the Bordelais and Romanée-Conti in Burgundy (Gasparotto and Neiman, 2019).

Producing a new red wine through a partnership between France and Spain

Spain has been the guest of honour of the Vinexpo Fair – the global meeting of the whole wine-making and trade industry –, that was held in the city of Bordeaux from 18 to 21 June 2017. But the glamour of this presence could not hide the tensions between Spain and France regarding the wine industry. Many wine-makers in the south of France have protested against the unfair competition of Spanish wines. It is true that Spain has the largest acreage of vineyards in the world: 975,000 hectares, according to the International Grapevine and Wine Organization. Although Spain was the world's third-biggest wine-producing country, just behind France and Italy, France increasingly imports cheap wine in bulk from Spain. Such low-cost competition was disturbing because many traders bottled Spanish wine and sold it under a French

brand, without clearly indicating the provenance of the wine for the consumers. That was also true of some big food and wine distributors who sell Spanish wine under their brand label. To bring some peace and calm down the anger of the French wine-makers and producers, a committee including representatives of both countries' viticulturists was created and will meet regularly to monitor the situation (Girard, 2017c).

In fact, cooperation exists between the two countries, as shown by the alliance between Benjamin de Rothschild and Vega Sicilia winery aimed at setting up a long-matured project in the heart of the Rioja Alavesa – a famous viticulture region in Spain (northeast of the country). The inauguration ceremony of the project took place on 16 June 2017, which coincided with the Vinexpo Fair (Bordeaux, 18-21 June 2017) with Spain as a guest of honour. The former King of Spain, Juan Carlos 1°, attended the ceremony. The project was developed in a secret way: Pablo Álvarez, the owner of Vega Sicilia winery, gradually selected the plots in the Rioja Alta and Alavesa, cultivated with 35-year-old grapevines and ubicated between the Cantabrian ridge and the Ebro River. The total acreage amounted to 120 hectares on which almost one grape variety was cultivated: the *tempranillo*. The project became a reality after a series of 70 rounds of negotiation over seven years. In the early 2000s, Pablo Álvarez met with the baroness Ariane de Rothschild. Both were willing to invest money in that vineyard which had already an appellation of certified origin and consequently a great potential. It is true that P. Álvarez had purchased Vega Sicilia winery in 1982 and achieved the objective of upgrading his wines among the renowned ones in the world; some vintages were sold at €250 or more the bottle. P. Álvarez also owns other wineries in Ribera Del Duero – region of Valladolid, centrenorth of the country – as well as the famous Tokay in Hungary. His company's annual turnover was estimated at €15 million (Girard, 2017c).

With respect to the Rothschild family it had a prestigious participation in the wine brand Château Lafite, first listed vintage of Pauillac; it also owned vineyards in the Bordelais. The family's involvement in wine-making and business was under the banner Edmond de Rothschild Heritage, with subsidiaries in New Zealand, Argentina and South Africa. But the Rioja project was born apart. Since 2015, Ariane de Rothschild who has been chairing the banking group Edmond de Rothschild, wanted to use this project as an illustrative example of how to build up new ventures. In fact, the project was a real challenge: on the one hand, to achieve profitability – a leitmotiv of the Rothschild group –, and on the other, to dare to invest €22 million, including €10 million for purchasing the vineyard. Important decisions had to be made, e.g. the architectural design of the cellar, which was not trendy, but operational and quite different from some bold architectures that attract wine tourists – in a region renowned for its enologic circuits. Another financial decision was made: the Benjamin de Rothschild-Vega Sicilia had not its own bottling line; it calls once a year on a French specialist who carries out the customized task. Finally, the project's director general Ignacio Calvo de Mora was in charge of making the new enterprise profitable. He was assisted by two technical directors (wine-making and viticulture), in charge of the quality of the product – a prerequisite for the success of the venture. For instance, they have limited the yields up to 3,000-4,000 kg of grapes per hectare, whereas in some Rioja vineyards, irrigated and planted thanks to the European Commission's assistance, yields can reach up to 10,000 kg of grapes per hectare (Girard, 2017c).

A name had to be found for the wine produced by the new alliance Benjamin de Rothschild and Vega Sicilia. It was not easy to find out, but finally the name *Macan* was chosen: it is derived from the nickname of the inhabitants living in the nearby village and was put, for the first time, on the label of 69,000 bottles of the 2009-vintage. Since then, *Macan* and *Macan Clasico* – a second wine produced by the alliance under the same brand – brought in a higher annual turnover: in 2016, it amounted to US$2.2 million and the 2013 vintage was sold at €50 the bottle among the wine-trading corporations. With their brand-new building, where stainless-steel vats and oak barrels or casks for the maturation and ageing of the wine are housed, the Benjamin de Rothschild and Vega Sicilia partners aimed to produce 320,000 bottles per year, and to sell their bottled wine at higher prices (Girard, 2017c).

SPIRITS AND COCKTAILS

Tequila, the coveted Mexican spirit

Tequila, derived from the fermentation of the sap of *Agave tequilera* and probably the most-widely consumed spirit in Mexico, is highly demanded across the world. It is not surprising that the spirit giants have been interested in purchasing some Mexican brands. This was the case of the world's leader, the British Diageo, who announced on 3 November 2014 that he has purchased the brand Don Julio. Diageo already held 50% of Don Julio's equity, and in order to acquire the whole company, he had to give away the northern Irish whiskey Bushmills. The negotiation was carried out with the Mexican family Beckmann, who owned the group José Cuervo that includes Don Julio. However, the growing consumption of this Mexican spirit beyond the frontiers of its country of origin is relatively recent. North Americans started to drink it during the 1980s, in the form of Margarita cocktails or straight ("shots"); and later on, they tasted various preparations of the spirit that broadened its consumption. As a result and according to Diageo, the global market value of tequila was estimated at US$6 billion by 2015, and 80% of total sales were made in the United States. In 2012, Diageo, well known for its Johnnie Walker whiskey, its Smirnoff vodka or Guinness beer, made a first attempt to purchase José Cuervo. Its value was then estimated at more than US$3 billion. But at the end of 2012, Diageo reckoned that the negotiations were unsuccessful with the Beckman family. At the beginning of 2013, Pernod Ricard was also interested in José Cuervo tequila, but its attempt also failed, while Diageo's offer was successful in November 2014 (Girard, 2014a).

Due to the success of tequila across the world, and especially in the United States, some companies tried to seize this opportunity. For instance, John Paul DeJoria, an American who after making a fortune in selling hair-care products, created the Patron Spirits Company. Patron, the tequila praised by American bartenders, became one of the three most-frequently-consumed tequilas. Even though José Cuervo tequila continues to lead the world's consumption, the Mexican label has nevertheless lost some ground: it is now under 30% of total consumption or sales. Meanwhile, Patron tequila reached the same level of sales as the Mexican brand Sauza. Other brands like Arion or DeLeon followed the pathway opened by Patron. Some bottles reached incredible prices: US$300 to US$1,000. Furthermore, American singers or actors, attracted by the potential profits to be drawn from the agave tequilera – blue agave – of the Mexican State of Jalisco, decided to create their own brand: Justin Timberlake or George Clooney who created their 901 Sauza and Casamigos tequila, respectively. The annual growth rate of the tequila market reached an average of 7.8% between 2010 and 2013; it even reached almost 30% for the very profitable high-end brands.

Spirit giants that are always trying to find a new start for their growth were involved rapidly in the tequila business. For instance, Pernod Ricard – the world's second-biggest spirit company – who owned part of the equity of Avion tequila in 2011 and signed with it an agreement for global distribution, did purchase it in July 2014. Its rival, Diageo, in January 2014 set up a partnership with the American rap singer Sean Combs, nicknamed Puff Daddy, with a view to purchasing the DeLeon tequila brand. Thereafter, it bought the Peligroso brand; and finally it added Don Julio to its portfolio – the annual turnover of Don Julio amounted to €134 million by 2015. Regarding the Sauza tequila brand, it was purchased by the Japanese company Suntory, whereas the group Bacardi-Martini that had a participation in the equity of Patron, was also distributing the brand (Girard, 2014a).

The complicated story of the Cuban rum

In 1992, Patrick Ricard, the chief executive officer (CEO) of Pernod Ricard, signed an agreement with Cuba with a view to commercializing the Havana Club rum at the global level; that brand had existed since the 1934, but it became part of the business reality in the 1970s. That was due to the efforts made by the national corporation Cubaron, several decades after the founder of the brand, the Arechabala family, was forced to leave the island after the Castrist Revolution. When Pernod Ricard became interested in the commercialization of Havana Club, it was hopefully expected that the American market would be opened to international business – the United States being the world's biggest consumer of rum. That did not happen. Nevertheless, the Cuban brand, because of the cocktail fashion and in particular the Cuban *mojito* (rum, sugar-cane juice, lemon and a blade of mint), and also because of the image of Cuba, sold 4 million crates in 2014, compared with 300,000 in 1993 (Girard, 2014b).

Such a success story drew the interest of the world's leading rum-production-and-trade company, the American Bacardi. The latter had been fighting for more than two decades with its rival, Pernod Ricard, challenging the rights of Havana Club in the United States. That rivalry started with the Cuban Revolution. The Bacardi family, whose properties had been confiscated, moved to Miami, Florida. Their rum was banned in Cuba, but in order to counter Pernod Ricard and the Castrist regime, Bacardi purchased the rights and the recipe to make the Havana Club rum from the heirs of the Arechabala family. In 1998, the company's lobbying resulted in the approval of the Bacardi Bill, that prohibited the registration in the United States of any trademark from countries under the American embargo. In 2012, the United States Supreme Court confirmed that Cuba and Pernod Ricard had no right on the Havana Club brand. But the French company prepared a counterattack: once the American embargo would be lifted, it would flood the United States' bars with bottles of Havanista, a brand registered in the United States. The ice began to thaw when President Barack Obama decided to progressively lift the embargo, in agreement with Cuba's new president, Raul Castro. American tourists visiting the island could bring back with them cigars and rum for a total amount of US$100. At that time, another Cuban brand has been, for two decades, the subject of a harsh guerrilla between the state's company Cubatabaco and the American corporation General Tobacco regarding the commercialization in the United States of the famous cigar-brand Cohiba – the preferred cigar of Fidel Castro until he decided to stop smoking (Girard, 2014b).

Cocktails: a global come-back

In the early 2000s, there were about 50 distilleries in the United States. In 2019 their number reached almost 1,500, due to the rebirth of the bourbon and other American whiskeys, and also to the revival of cocktails. Even though the aristocracy of the Scotch whiskey has scorned this art of mixing and blending (cocktails), the situation was different on the other side of the Atlantic. Once overtaken in the 1980s and 1990s by the vodka fashion, cocktails were coming back on the top of the "50 classic cocktails, the most highly appreciated in the world," as published in the magazine *Drinks International*. The Old-fashioned cocktail – bourbon or rye whiskey, a lump of sugar sprayed with a few drops of bitter Angostura, water and a piece of lemon peel – ranked first. Then, the number three was the whiskey sour – American whiskey, lemon juice and eventually egg white – and the number five was the Manhattan – red vermouth, rye whiskey, Angostura and maraschino cherry (Davet, 2019b).

Before the bourbon whiskey, originally made in the State of Kentucky from a mixture of cereals, containing at least 51% of maize, became a dominant drink after the Prohibition period, rye whiskeys, drier and spicy, made up the majority of whiskeys in the United States. To meet the needs of bartenders looking for vintage products, many independent distilleries started again to make rye whiskeys, such as: Widow Jane and the NY Distilling Co., produced in New York, or the F.E.W distilled in Chicago, or Dad's Hat, produced in Pennsylvania, the cradle of rye whiskey. Often escaping the regulation on the bourbon appellation, these craft distilleries competed successfully in terms of creativity: such as Sonoma – a whiskey smoked with cherry wood – that is produced in California, or Koval which, in addition to its bourbon and rye whiskeys, distilled a whiskey fermented from millet in Illinois, as well as a Four Grains whiskey containing oats. A few big companies, after having been pushed aside for a long period, joined the current trend, like the Heaven Hill distillery that produced the Elijah Craig and Evan Williams bourbons, as well as the Rittenhouse and Pikesville ryes; like also the Buffalo Trace distillery which produced such expensive brands as Sazerac or Pappy Van Winkle – that the connaisseurs prefer to drink straight and not in cocktails (Davet, 2019b).

Old cocktails, still highly appreciated

Kir

This mixture of dry white wine and blackcurrant cream was supposedly made for the first time by the canon Felix Kir, who has been an elected parliamentarian and mayor, from 1945 to 1968, of the city of Dijon (centreeast of France, near the Burgundy vineyards). The cocktail bears the name of the canon: it is a short denomination that also soothes the ears. But the real discovery was made earlier in 1904, in a bar of Dijon: the bartender wanted to heighten the image a plain white wine through the addition of blackcurrant cream. The mayor of Dijon at that time (1904-1908), Henri Barabant, who was living just above the bar, had appreciated the new drink and made it served during the receptions at the city hall. The drink became very popular in Burgundy between the two World Wars, spreading through the whole country during 1950s.

On 20 November 1951, the canon Kir gave the exclusive right to the distillery Lejay-Lagoute, in Dijon, to use his name for "advertising blackcurrant, in the relevant form, and mainly to designate a mixture of blackcurrant and white wine." Thus the "white wine-blackcurrant" became the *kir* and in 1952 Lejay-Lagoute registered the brand *Un kir*. The latter referred to a drink containing one-third of blackcurrant cream and two-thirds of a white wine variety called Bourgogne aligoté. Another brand was also registered by Lejay-Lagoute: *Kir Royal*, made of blackcurrant cream and a Burgundy sparkling wine – *crémant de Bourgogne* (Denys and Malécot, 2017).

The story of the kir became complicated when, in February 1955, the canon Kir authorized another liquor-maker from Dijon, L'Héritier-Guyot, to use his name for advertising the drink. He explained that he did not want to create a monopolistic situation. But at the same time Felix Kir opened the way to one of the longest lawsuits in the beverage industry: this opposed Lejay-Lagoute to all other liquor-makers in Dijon. In 1992, the French Supreme Court (*Cour of Cassation*) decided that Lejay-Lagoute will be the only user of the brand *Un Kir* for its ready-made drinks. The story of the kir was also that of the Dijon's blackcurrant cream. In 1841, Auguste-Denis Lagoute, owner of the *Café des Mille Colonnes*, developed a recipe of the blackurrant liquor that could be used on industrial scale. The inventor and his descendants understood the importance of the name of Dijon for their sales efforts. In 1923, the court of appeals of Dijon stated that the product called *blackcurrant of Dijon* should be manufactured only in that city. That decision was confirmed in 1989 by the European Community and in 2013 the liquor obtained the appellation of protected geographic indication (IGP, French acronym). Nowadays, the four liquor-makers, Lejay-Lagoute, L'Héritier-Guyot, Briottet and Gabriel Boudier, are the only ones that can use this IGP. In 2015, 16.5 million bottles of blackcurrant cream of Dijon were produced, i.e. 80% of the French production and half of it was exported. The four companies are defending their monopolistic position, as they are being challenged by the *blackcurrant cream of Burgundy*, which also has been awarded an IGP (Denys and Malécot, 2017).

Spritz and prosecco

In the 19th century, Italy was divided into several kingdoms. In the north, the Habsburg dynasty was in command of Lombardia and Venetia (Veneto) – 1815-1866. In Venetia, local wines were highly appreciated by the Austrian soldiers. In Venice, the representatives of Emperor Francis-Joseph (Habsburg) and the local youth, used to come out of Plaza San Marco's cafés, almost drunk. The Austrian officers therefore decided to request the tavern-and inn-keepers to pour water into their wines: to spray them with fizzy water in order to make them lighter – the German word for this process was *spritzen*. At that time, there were cholera outbreaks – and the tapwater was often unhealthy and not drinkable. That is why, in order to avoid any risk of disease, substitutes were replacing water: a fizzy water or Seltz water – the name of the village where natural sparkling springs were found. This kind of spring water was very trendy across Europe at the beginning of the 19th century. The *spritz* was therefore born: one third of glass filled with fizzy water or Seltz water, six centiliters of a sparkling white wine and four centiliters of bitter spirit. The *spritz* became a cocktail through the addition of local bitter spirits, such as the Campari in Milano, the Aperol in Padova or the Select in Venice (Dealberto, Fattori and Papin, 2017).

The Campari was developed in 1860 and the Aperol in 1919. In Venice, the Select, produced since 1920 in the Murano Island, is the preferred spirit added to the *spritz*, while in Brescia (Lombardia) it is the Campari and in Friuli, the Aperol. During the 20th century, the *spritz* continued to be a regional drink. In 2003, the group Campari purchased Aperol with a view to becoming an important spirit corporation in Italy and beyond its borders. The challenge was to carry out an advertisement campaign that associated the original *spritz* with Aperol, with a view to making it the trendy drink praised by "young adults with a busy social life." This strategy met with a considerable success across Italy and since 2010 the drink has been present on the international market. For instance, in France, the first success of the Aperol *spritz* occurred around Paris and in the South-East of the country. The volumes of Aperol sold in France reached 750,000 liters in 2015 from 10,000 liters in 2011. Inn-keepers and restaurant owners could bill the Aperol for €10 a glass, while they bought it at €1. France is the third-biggest commercial market of Aperol behind Germany and Italy of course. In Venice, in 2015-2016, *ca*. 200 glasses of *spritz* were swallowed every minute according to local bartenders (Dealberto, Fattori and Papin, 2017).

Prosecco

As a result of the spritzmania, the sales and exports of *prosecco*, an Italian sparkling white wine, often associated with the *spritz*, have risen. It was a district of Trieste, Friule, which gave its name to the *prosecco*. But the appellation *prosecco* extends beyond this town, and the vineyards producing this so-called *frizzante* (sparkling) wine had an acreage of 44,000 hectares in 2018. This acreage includes nine provinces, four of which are in Friule and five in Veneto. In the latter, near the city of Trevisa, in the Valdobbiadene, is ubicated the "jewel" of *prosecco*, consisting of *ca*. one hundred hectares. This is called the Cartizze, a natural amphitheater of 107 ha of vineyards. The hills of Valdobbiadene and those of Conegliano have become part of the UNESCO World's Cultural Heritage List in July 2019 (Gasparotto, 2019).

Ca. 600 million bottles of *prosecco* are produced annually (2018) compared with 360 million bottles of champagne. This production rose 75% in fifteen years and it could lead sometimes to an overexploitation of the vineyards. Henceforth, the need for an international chart aimed at protecting the appellation. The average acreage of the vineyards is rather small: between 2 and 5 hectares, belonging to families of vine-growers and wine-makers who sell their production to trade companies. According to *prosecco* producers, interviewed by Laure Gasparotto (2019) of the French weekly *Le Monde Magazine*, "this wine is part of a lifestyle; people living in the sparkling-wine production provinces drink it with any kind of food available locally. *Prosecco* is our daily wine." And that explains the amazing success of the *prosecco*: a wine easy to drink, with very small bubbles, that is not ceremonial compared with champagne or the Catalan *cava*, which are often decorked to celebrate a special event. The most expensive *proseccos* cost €15 to €20 the bottle, the average price being between €8 and €12. This price depends on the location of the vineyards – those ubicated in the lowlands demand five times less working hours than those located on the hills (Gasparotto, 2019).

In 2019, the exports of the sparkling wine rose 25%, thus confirming the success of the *prosecco*. France was the outlet of a large part of the exports, but behind the United Kingdom which receives two-thirds of the exports. Wine-makers were somewhat concerned about the "Brexit", but they thought that the outstanding quality of the 2019 vintage would help maintain the volumes of exports to the United Kingdom. With the *prosecco* topping the list of its wines, Italy became in 2018 the global leader regarding wine production according the International Grapevine and Wine Association, ahead of Spain and France, who had been hit by extreme weather events (Gasparotto, 2019).

Picon beer

In 1837, Gaëton Picon, a young man coming from Genoa and settled in Marseille, belonged to the French army cavalry in Algeria – still "a French department" –, in the city of Philippeville (now Skikda), centrenortheast of the country. Like many of his fellow soldiers he was suffering from the lack of drinkable water and malaria. As a former worker of a distillery in Marseille, he revisited a recipe that cured him during his youth: it consisted of macerating or soaking orange peels, cinchona and gentian in alcohol. This thirst-quenching and antipyretic infusion was quite successful among the soldiers and it convinced General Vallée, future governor-general of Algeria (1837-1840), to request Gaëton Picon to increase the production of this infusion with a view to supplying it to the troops. Commercialized under the name of "African bitters", the beverage was rapidly adopted by the French settlers in Algeria. The demand rose to the point that distilleries spread throughout Algeria, but also in France, where the name of the infusion changed after the return of Gaëton Picon to Marseille. Called *Picon*, it is mixed with hot water and honey as a grog, or with milk, wine or tonic water. *Picon* is therefore consumed is several forms and it became in 1930 "the preferred aperitif drink of the French people." In 1967, when the brand made a spectacular and successful commercial operation, *Picon* started to be mixed with beer. Thereafter, the *Picon* moves from the Mediterranean bars and restaurants to the north of France, where it upheaved the local habits. In the beer-producing regions, it was traditional, during the festive aperitif drinks, to add liquors made of fruits and containing spices to the beer: they were called the "bitter beers". In 2016, according to Moët Hennessy Diageo, in charge of distributing the *Picon*, the northeast of France became the region where more than two-thirds of the 4.6 million liters of this beverage were sold (Denys, Fattori and Malécot, 2017).

Also, the *Picon* beer is the bitter beer mostly consumed in the east of France. In Alsace, the *Sommer* contains orange and cinchona; in Lorraine, the *Picabel* contains plum brandy. The Picon beer is generally a light ale (Pilsner type), but the mixture with stout beers is also possible. *Picon* can also be mixed with white wine: Picon Club, commercialized since 1975. Mixed with champagne, it is called Picon Royal or Picon Wall Street. The *Picon* could have remained a regional drink, but in 2012, the year of the 175th anniversary of the brand, the bottle was redesigned in a retro style – bearing the colours of three Epinal images belonging to French popular art heritage – by Lorant Deutsch who authored several best sellers on the history of France (Denys, Fattori and Malécot, 2017).

Cuban mojito

Mojito comes from a word used by Afro-American slaves to mean spell, legend (*mojo*). Everybody also agrees that *mojito* was born in Cuba and that its ingredients include unrefined rum, sugar, lime and mint. But there is no agreement about who was or were its inventors. The first story goes back to the 16th century when the British corsair and slave-driver Francis Drake – others would say a highly appreciated sailor and admired by Queen Elizabeth the First – attacked Cuba, a Spanish trading post where the gold of the Aztecs was supposed to be hidden. The expedition failed (1586), but a sailor of the British fleet created "El Draque", *the dragon*, a cocktail aimed to praise the admiral. Another version of the story is that the *mojito* was created at the same period by slaves working in sugar-cane fields in Cuba. The third story refers to the period between the two World Wars and to the Americans who left the United States and moved to the Caribbean island during the Prohibition period: the *mojito* would be the Cuban version of the *mint-julep*, a classical American cocktail that contains sugar, mint and cognac or whiskey. In the Cuban drink, the spirit was replaced by rum – most often the Bacardi Carta Blanca brand, a frequent ingredient of cocktails (Denys, Desrayaud and Gittus, 2017).

The three stories converged in Havana in 1946, when a mythical bar was opened: the *Bodeguita del Medio*. The bar owner, Ángel Martínez, proposed a more sophisticated version of the draque to his clients. He added to the rum a little of fizzy water and christened the whole mixture "*Mojito*". Ernest Hemingway, who was present in Cuba from 1928 to 1960, was a fine connaisseur of Cuban cocktails: "My *mojito* at The Bodeguita and my *daiquiri* at The Floridita," he used to say. The cocktail was rapidly exported to Florida and to the big cities of the United States, and thereafter to Europe during the 1960s, when the *tex-mex* cuisine became trendy. The global distribution of the *mojito* was fostered by the involvement of the French spirit group Pernod Ricard in the rum market (Denys, Desrayaud and Gittus, 2017).

Pernod-Ricard found an appropriate ubication in the market of industrial rums – derived from molasses, a residue of the extraction of cane sugar –, and it was able to target consumers that do not drink pure rum, but blend it to make a *mojito*. By doing so, the French group did not encroach on the very competitive market of agricultural rums – derived from the fermentation of sugar-cane juice and its following distillation. France was the world's first-biggest producer of agricultural rums thanks to its overseas departments. The fashionable *mojito* trend and Cuba's image resulted in selling Pernod Ricard's rum brand Havana Club in more than 120 countries: exports reached 4 million crates from 300,000 crates in 1993. But due to the American embargo since 1962, Pernod Ricard could not sell its Havana Club in the United States which represented 40% of the world's consumption. In this country, Pernod Ricard's rival, Bacardi, was able to commercialize a rum named Havana Club thanks to an *ad hoc* 1998 "Bacardi Bill": Bacardi indeed was granted the exclusive right to commercialize in the United States its Havana Club, produced in Porto Rico. In 2015, on the French market, Havana Club was in terms of volumes the dominant industrial rum: 43.1% for Havana Club (Pernod Ricard), 30.7% for Captain Morgan (Diageo), 22.6% for Bacardi (Bacardi-Martini) and 3.6% for other rums (Denys, Desrayaud and Gittus, 2017). See also p. 386.

The competition between Pernod-Ricard and Bacardi fostered the market and *mojito* was on the top of cocktails served in the United Kingdom and France, where 56% of the consumers drink cocktails outside their household. The basic recipe of the *mojito* consists of two tea-spoons of cane sugar, three centiliters of lime juice, four centiliters of white rum, fizzy water and six blades of mint. There is a luxurious version of the *mojito*, where champagne replaces the fizzy water: it is the *royal mojito*. In some trendy bars, part of the fizzy water is replaced by strawberry juice (*strawberry mojito*). Other spirits can replace the rum, e.g. the Brazilian spirit *cachaça* (*Brazilian mojito*), Armagnac or even pastis (*milky mojito*). It is also possible to make non-alcoholic versions of the *mojito*, e.g. the *virgin mojito*, where rum is replaced by lemon, pineapple or apple juice (Denys, Desrayaud and Gittus, 2017).

Gin tonic

This spirit flavoured with juniper berries has its origin in the Netherlands, and it made its inroad into England with the British soldiers that were combatting the Spaniards and Dutchmen during the 17th century. On the battlefields, this beverage used to give a perk to the exhausted soldiers; for this reason, it was named "Dutch courage." Around 1650, in the Netherlands, a Dutch physician, Franciscus de le Boë, started to distillate the liquor from juniper berries – an ancestor of gin. When William d'Orange (William IV Orange-Nassau) became King of England in 1669, he decided to promote the gin beverage in order to drastically reduce the consumption of Cognac – produced by England's enemy at that time. The alcohol was not taxed, it was poorly regulated and it was easy to produce gin at a cheap price. That was the beginning of an uncontrolled consumption of gin that wreck havoc on the population, and for this reason the gin was christened the "wreck of mothers". With respect to the second ingredient of the beverage, tonic water, it is also associated with the history of the British Empire. Since the mid-18th century, in India, British soldiers and settlers far from their homeland were very often suffering from malaria; they used to take powdered quinine – extracted from the bark of a medicinal tree originally from the Andes, Peru and Ecuador (*Cinchona officinalis* or quinine tree); the quinine powder was diluted in sweetened fizzy water, that was healthier than still water drawn from a well. In order to alleviate its bitter taste, the soldiers added to this medicine a dose of their daily gin ration; that was the birth of gin tonic in 1825 (Denys and Fattori, 2017).

The mixture was rapidly improved and it became a recreation beverage thanks to the commercialization of ready-to-use tonic waters. Schweppes was present on the market for the first time in 1870 with its Indian Tonic brand. Gin tonic consists, in terms of volume, of two-thirds of tonic water and one-third of gin. Quite often a slice of lemon is added to the beverage, but it is possible to change that and to add a few slices of cucumber or a piece of grapefruit peel. Tonic water can be replaced by champagne (gin rémois) or cider (apple gin) or ginger ale (ginger gin). In order to reduce gin tonic's alcoholic degree, it is possible to replace the gin by Lillet blanc, an aperitive liquor containing wine and quinine (Denys and Fattori, 2017).

Highly appreciated by the aristocracy, gin tonic became gradually popular during the 20th century, reaching a peak in the 1980s and 1990s. The "gin tonic" was the ideal beverage in society; it could even be, in the right sense, shining because in the night-clubs the sensitivity of quinine to ultraviolet radiations makes fluorescent the glasses filled with gin tonic. Thereafter, the consumption of the cocktail declined. One had to wait the new millennium and also the frequent journeys beyond the Pyrénées Mountains, to observe a gin tonic renaissance. In 1999, the Spanish gastronome journalist and writer Rafael García Santos launched in San Sebastián the congress "*Le Meilleur de la Gastronomie*" (The Best of the Gastronomy). He invited his guests to relax in a bar, The Dickens, renowned for its outstanding gin tonics. The experience was so successful that chefs put again the cocktail on their bills of fare. But we were far from the real "gin to". The beverage was in fact derived from a deep and customized search for several additional flavours, e.g. spices, herbs, fruits, flowers. Thanks to this new trend, Spain became the world's third-biggest consumer of gin – we can find at least 300 references in this country – and it has developed a local and high-end craft production. The gin-tonic fashion moved to France that has about 30 gin distilleries, compared with 233 in the United Kingdom in 2015, i.e. twice the 2010 figure. In 2016, *ca*. 40 million bottles were sold in the United Kingdom, i.e. enough to prepare more than a billion gin tonics. At that time, the main gin markets (in million liters) were: the Philippines (157.3 million liters), the United States (90.7), Spain (41.4), United Kingdom (33.8), Uganda (27.1). The main producers of gin (in million liters) were: the Philippines (156.4 million liters), United States (55.5), United Kingdom (31.8), Uganda (27.1) and India (24.9). If some have whispered that Queen Elisabeth II used to sip her gin tonic before dinner, Winston Churchill, the late Prime Minister of the United Kingdom, who was fond of good food, havana cigars and gin tonic, stated: "Gin tonic has saved more lives and English minds than all the physicians of the Empire." This might be a special tribute to what could be called Her Majesty's imperial cocktail (Denys and Fattori, 2017).

Pastis, a very popular drink in the south of France

In 1915, absinthe was prohibited in France, because of its association with dementia. In spite of a 1914 law that prohibited beverages containing more than 16 Gay-Lussac degrees of alcohol, many investigators tried to find substitutes to absinthe, which used to be consumed with cold water. Between the two World Wars, the alcohol concentration has been increased and aniseed-flavoured drinks were becoming more available to the consumers, although their composition was sometimes controversial. In 1932, Paul Ricard, a 23-year-old man, designed a recipe which he tested in Marseille, and then commercialized it as *pastis* – meaning mixture in the southeastern language of France. P. Ricard was the son of a wine merchant; he gave his name to the beverage and also ushered a slogan: "Ricard, the true pastis of Marseille." In 1938, a new law enabled him to commercialize a spirit with 45° of alcohol and containing 2 g of anethol (aniseed oil) per liter (Dealberto and Desrayaud, 2017).

A rival of P. Ricard, who was the main producer of absinthe, Henri-Louis Pernod produced an aniseed-flavoured beverage, called Pernod 40 and Pernod 45, without labeling them as *pastis*. In 1940, the Vichy regime made decision to prohibit these

alcoholic beverages: the Pernod factory became a chocolate factory, while Ricard was pushed towards fruit-juice and vermouth production. After the Second World War, the beverage alcohol-content rose to 40°, but in 1948 the aniseed-flavoured beverages, containing 45°of alcohol, were authorized. Such regulations did not prevent Paul Ricard to associate his brand with the Tour de France – the world-famous bicycle French tour – since 1948. During the following year, Pernod tried to imitate the same advertisement strategy, while P. Ricard had to face the 1951 prohibition of advertising alcoholic beverages in the press and posters; he had therefore to play with items displaying its brand, e.g. ash-trays or bottles of water. He even called himself "the friend of water." The success was amazing: the production of Ricard rose from 250,000 liters in 1932 to 60 million liters in 1972. Ricard became the world's biggest trader of aniseed-flavoured beverages and in 1975 he merged with his rival Pernod: the brand became Pernod-Ricard. The latter, in 2015-2016, represented 53.1% of sales. Ricard is the aperitif drink, before lunch or dinner, that is most-widely sold across the French territory – with 24.3 million liters in medium- or large-sized supermarkets, far ahead of the vermouth Martini (11.5 million liters). A few other *pastis* brands can be found in the bars, such as Duval, Berger or Casanis (Dealberto and Desrayaud, 2017).

The drink, as generally consumed, contains two centiliters of *pastis* and ten centiliters of cold or iced water. The *pastis* poured in the glass contains 45% alcohol, 54.8% of water and 0.2% of anethol. The latter is only soluble in alcohol (45% or above). When water is added, the alcohol concentration decreases and anethol forms tiny droplets which reflect the incoming light; thereafter the liquid becomes opaque or even milky. Syrups could be abled to the *pastis*: almond milk or orgeat (*Mauresque pastis*), mint (*parrot pastis*), grenadine (*tomato pastis*), lemon (*sunshine pastis*), and the duo grenadine-mint (*deadleaf pastis*). In 2010, in order to attract new consumers and also to give a younger image of the brand, Pernod-Ricard produced a more elegant beverage called *51 Piscine* (51 Swimming Pool): a mixture of one part (volume) of *pastis* and seven parts of water instead of five, with many ice cubes in a wider glass, designed by Tabas – a graphist from Marseille. Drinking *pastis* is not anymore confined to the south of France, it is also drunk in Paris, and all the brands struggle to lure a wider range of consumers. There are some *pastis* called "traditional" or produced from craftsmanship, like that of Henri Bardouin, containing more than 60 ingredients and developed in 1990, or that of Jean Boyer; all can be found in trendy bars and some grocery shops. Despite the cancellation of the 2011 law that prohibited absinthe, the *pastis* or "yellow drink" remained highly popular: in 2015, 74 million liters have been consumed in France, i.e. *ca*. 3.7 billions of standard glasses. While Pernod-Ricard continues to be the dominant producer and trader on global scale, there are around the Mediterranean several local anisettes, such as *anis del mono* (Badalona, Spain), *anisette Cristal* (Algeria), *sambuca* (Rome), *mastika* (Bulgaria), *ouzo* (Greece), *raki* (Turkey, Armenia), *arak* (Lebanon, Syria, Jordan, Israel and Palestine) [Dealberto and Desrayaud, 2017].

The return of vermouth and its derived cocktails

In Torino, Piemont, at the bar-restaurant Affini, Davide Terenzio Pinto, the owner of this very trendy place, stated: "The return of cocktails should be that of the vermouth." He said so, next to a bottle of Anselmo Reserva Rosso, a craft vermouth produced by

himself, with a vanilla-flavoured bitterness. Some ten years ago, in 2009, this former anthropologist who was converted into a clever night-club and bar attendant, has found the heirs of this brand that disappeared in the 1960s; he convinced them that he could revive the brand. "What is the common feature shared by very popular cocktails such as the Manhattan, Martini Dry, Negroni or Americano? All of them contain vermouth, like almost 40% of cocktails," explained Tigre Ciliego, the colleague and friend of Davide Terenzio Pinto. The latter also contributed to the revival of the aperitif, with its brand Carlo Alberto. Thus after decades of obsolescence, the vermouth rose at the forefront of the bars worldwide (Davet, 2019b).

In 1786 in Torino, was made, for the first time, a wine fortified through the addition of alcohol; it was also flavoured with bitter and tonic plants. That was the work of a distiller, Antonio Benedetto Carpano, who was inspired by a recipe of a German aperitif containing wine and *wermut*, meaning absinthe in German. Existing in *rosso* (red), *bianco* (white), dry or extra dry (dry white wine), and also having the colour of a claret wine, the vermouth was produced by such historical companies as Martini, Cinzano, Carpano, Gancia, as well as by a lot of new craftsmen – in Torino there were at least 35 of them. The various versions of the vermouth were present throughout the capital of Piemonte in all places devoted to the art of snacking before lunch or dinner. Thus, in the renowned Caffé Mulassano, one can eat small whitebread sandwiches, called *tramezzini*, accompanied with green olives and *saltini* (salted petit fours), while drinking an *Americano* – 1/2 vermouth rosso, 1/2 bitter vermouth, Campari type, a drop of fizzy water and a slice of orange – or a *Negroni* – the same as the *Americano*, but without water and gin added. The most famous restaurant of the city, Ristorante Del Cambio, serves the Gran Torino – bourbon, vermouth, sage, liquor of gianduiotto. In addition, Torino acknowledged a wave of creativity aiming to discover and make cocktails (mixology), that are drunk in a lot of bars by young people. Conscious of their heritage, the new entrepreneurs in charge of the local gastronomy, did not forget to emphasize the role of the vermouth. That is the case of the innovations found in the Mercato Centrale, an immense food court – Porta Palazzo – that includes craftsmen, trendy chefs, but also a large cocktail bar, Distilleria, that serves traditional (craft) vermouths. Also in the same area, Oscar Farinetti is present – the man who conceived Eataly – the giant luxury grocery – and opened his first shop in Torino in 2007 (Davet, 2019b).

Since 1864, the Martini brand of aperitif wines has maintained its global leadership – the production reached *ca*. 100 million bottles per year in 2019. The Casa Martini museum, located 15 km south of Torino in the village of Chieri-Pessione welcomes *ca*. 30,000 visitors every year. In its 19th century buildings, very close to a production site, tourists and clients can trace back the saga of aromatic wines since Antiquity as well as rediscover the story of this Italian industry's jewel – purchased by Bacardi in 1922. They also learn more about the botany of aromatic plants and the preparation of cocktails. Even though the Martini corporation was not the first to commercialize vermouth, the company and brand, propelled for more than 150 years ago by Alessandro Martini and Luigi Rossi, have pioneered the globalization of the vermouth and its integration within the world of cocktails, especially in the United States and thereafter in Cuba. "In 1900, Martini-Rossi was exporting to 70 countries," recalled Giuseppe Musso, an

enologist specialized in the blending of wines, who grew up a few kilometres from Pessione, and who with the master herbalist Ivano Tonutti, were the key designers of the brand's vermouths. Nowadays, the Martini *Bianco* (white, sweet) leads the global sales (50%), followed by the *Rosso* (30%), the Dry and *Rosé* (10% each). "Wines are the backbone of the vermouth, while plants and spices beef them up," stated G. Musso. "You need white wines that are quite acid and have a neutral taste, like those produced by the grape variety *trebbiano*. It is the addition of caramel that gives its colour to the *Rosso*." *Ca*. 60% of the thirty plant species – e.g. absinthe, camomille, mint, coriander, lemon-balm and hyssop – that are used in the maceration of wines, are produced by *ca*. 20 craftsmen from the nearby village of Pancalieri. The rest of herbs, spices and fruits – cinnamon, nutmeg, clover, bitter orange, vanilla – have for many years been imported through the harbour of Genoa, connected to the railway station of Pessione. From the 1960s to the end of the 1990s, the vermouth that was the symbol of a traditional gentry, lost ground. "People stopped drinking vermouth, but they never stopped drinking Martini," explained Giuseppe Musso. The brand has become a generic drink whose image was constantly updated thanks to a marketing policy targeting especially the show-business and sport (Davet, 2019b).

Martini was not unhappy about the come-back of the aperitif, triggered to some extent by the success of Aperol, the Padova bitter orange and fluo (property of Campari), often associated with the *spritz*, which Martini tried to compete with thanks to a new product called the *Fiero*. Giuseppe Musso has designed for Martini premium bottles of *Vermouth di Torino* – an official appellation created in 2017 –, the excellent *Riserva speciale Rubino,* containing *Barolo* red wine, and *Ambrato*, containing Asti muscat, that were adopted by outstanding bartenders. The craft-vermouth producers try to distinguish themselves from the industry, for instance through using more aromatic grape varieties, such as the *muscatel* or the *Erbaluce di Caluso*, or through maturing their wines in barrels or using more herbs or spices. If all these craft-vermouths contain absinthe, some of them contain rhubarb (Drapo brand), tonka bean (Carlo Alberto), hops (vermouth, produced by the brewer Baladin) or scents of violet and cherry flower (Sakura de Mancino). Recently, the chocolate-maker Guido Castagna included cacao beans in the batch of aromatic plants whose proportions are kept secret; he thus produced a special vermouth, that combined the two well-known products of Torino: vermouth and chocolate (Davet, 2019b).

Whiskeys on the rocks

Lynchburg, Tennessee, United States, is the cradle of Jack Daniel's distillery. As paradoxical it may seem, the tiny county of Moore (6,400 inhabitants) of which Lynchburg is the administrative seat, is a dry county, located in the Bible Belt of the south of the United States, where the sale of alcohol is prohibited. "This does not prevent many inhabitants to have at home well-stocked bars," explained Jeff Arnett, the distiller in chief of Jack Daniel's, who has nevertheless the authorization to provide "educational tastings" in his worksite. Located 120 km south of Nashville, the Lynchburg distillery is the only one that produces the whiskeys of the brand. Since

1957, it has been the property of Brown-Forman Corporation and it employs 400 people; there is also a small museum and vintage spaces that have kept the charm of the South of the United States (Davet, 2019b).

A key stopover of the guided visits, the cave, called Cave Spring, is where the spring gushes out of the bottom of chalk cliffs; the water is very pure there and this enticed Jasper Newton Daniel to set up there his first stills at the end of the 1860s. This scion of a poor family of ten children made this decision when the rye whiskeys were dominant on the market. He used to distillate alcohol derived mainly from the fermentation of maize – a cereal crop well adapted to the regional environment – and make a spirit with a sweeter savour. Created in 1904, the mythic Old No.7 remains the best seller of the brand. The recipe remains the same: 80% of maize, 12% of malted barley and 8% rye ("sour mash"). The sweet savour is due to the maize and also to the way the American white-oak barrels, all brand new, are toasted, in order to "caramelize the sugars of the wood and increase the vanilla aromas," explained Jeff Arnett. This carbonization creates in the barrel a natural filter that evolves during the seasons – when the weather is warm the whiskey infiltrates the wood, whereas when the weather is cold the whiskey leaves out the wood – and gives to the whiskey its taste and colour. What is the difference between Jack Daniel's whiskey and the bourbon, produced in the nearby State of Kentucky? In the case of Jack Daniel's, before transferring the distillate into the oak barrel, it is filtered through three meters of maple charcoal. That process, called "of the county of Lincoln," eliminates the bitterness of the cereals and sweeten again the future Tennessee whiskey. This is stored for at least two years in very large and air-conditioned warehouses – up to 60,000 barrels having a volume of 200 liters each are stored there (Davet, 2019b).

The range of Jack Daniel's whiskeys has been broadened: in 1988, Gentleman Jack, filtered twice, was launched; in 1997, Single Barrel that is derived from a single barrel and is appreciated by the whiskey purists; in 2017, Rye, drier and peppered, was on the market at a time when the cocktail scene was renewed; in 2011, Tennessee Honey which has a savour of honey, or in 2015, the Tennessee Fire with a cinnamon savour. But the No.7 remains the emblematic bottle of the rock generation: Frank Sinatra ("The Voice") was the first to make Jack Daniel's the brand of the rock stars. It was not surprising that since 2013 a vintage whiskey, the Sinatra Select, has been created to honour him; this whiskey was matured in barrels with special fluting. Among the numerous singers who were like the crooner fond of Lynchburg's whiskey, the Rolling Stones had a bottle designed for them. In 2016, an American writer, Fawn Weaver, discovered that Jack Daniel who passed away in 1911 had been initiated to the art of distillation by a slave, Nathan "Nearest" Green. The latter, became, after the end of the Secession War, the first chief distiller of the future most famous brand of whiskey in the world – the Scotch whiskeys and their single malts have also their global fame and their connaisseurs. The story concerning the education of Jack Daniel by a slave is part of the guided tour of the distillery and it is also a symbol of the contribution of both White and Afro-American cultures to crafting a spirit of global reputation (Davet, 2019b).

Spirit-free cocktails: another creative trend

Some gourmets replied no to this question. In their opinion, these were simple mixtures of fruit juices; they are sidelined next to the soft drinks and they progressively disappear from the bars' or restaurants' bills of fare. It is true that for a long time whoever wanted to order non-alcoholic cocktail in a bar, he or she was offered two options: either an ordinary version of the *Virgin Mojito* where alcohol is replaced by sugar, or a syrup with water or soda, the colour and savour of which would remind those of some well-known alcoholic drinks. But the drinker is deprived of cocktail experience, i.e. the mixture or blending of a range of savours, flavours and textures, and of the show of the bartender who mixes all these ingredients. But others claim that we are seeing another trendy wave: that of spirit-free cocktails. These spirit-free cocktails, named Seed lip, Bax Botanics, Ish Spirits or Everleaf, came from the United Kingdom, the United States and Scandinavia, and they all lay emphasis on the aromatic power of herbs, spices and plants, while avoiding the use of alcohol as the savour- and-flavour vector. The manufacturers of these spirit-free cocktails carry out the maceration or infusion of aromatic compounds in water before distilling the mixture in the same way as the distillation of a brandy. Water vapour is channeled through the still and enriched with aromas before coming out in a liquid form and giving rise to a distillate – i.e. a mixture having the flavours and savours and that looks like a liquor which the bartenders can use as a basis for their creations. "The spirit-free has become part of a deep trend in the bar world. It is more and more enthusiastically praised by both the bartenders and customers," explained Eric Fossard, associate director at Liquid Liquid – a specialized consultancy in spirits. "It is a cross-cutting trend which responds to the expectations of *mindful drinking,* that is to say that one can drink less, but better. For those who do not consume alcohol, there is an opportunity to enjoy a tasteful experience similar to that of alcoholic-cocktail drinkers – although different. It is also an opportunity for distillers and cocktail-makers to escape from their usual frame of work and to venture into different worlds," he added (Bourdin, 2020).

The spirit-free and non-alcoholic distillates were born, as it is often the case for this kind of beverage adventures, is a kitchen located above a garage: that of Ben Branson, the founder of the Seedlife startup. In 2013, this young English farmer set up a copper still above his kitchen sink. Relying on medical recipes made of plants which he found in an English 18th century book, *The Art Of Distillation*, he was able to distillate the first spirit-free liquors. In order to provide the same tasteful experience as an alcoholic distillate, he used the maceration of plants, aromatic herbs and spices in different kinds of water, and thereafter he distillated each one of them. In 2015, the first bottles or flasks of Spice 94, an aromatic and complex mixture of Jamaican pepper, cardamon, lemon peel and slice, met with a great success. Nowadays, Seedlip produces three basic mixtures for the manufacture of numerous cocktails. This brand is distributed in *ca*. 20 countries and is on the bill of fare of 250 restaurants and cocktail bars, such as the Clover Club in New York, the Fat Duck and the bar of the Savoy Hotel in London, and the Mary Celeste and Little Red Door in Paris. In 2019, Seedlip has been purchased by Distill Ventures, a subsidiary of Diageo – the world's leader in spirits. Its rival, Pernod Ricard, has shown a similar interest in this trend and has launched a first spirit-free beverage named Ceder – a beverage that tastes like gin, but without alcohol. In France,

in December 2019, Romuald Vincent, a producer of vermouth and aperitif wines in the Charente department (centrewest of the country), was the first to commercialize Djin – a spirit-free beverage having the same aromatic basis as gin (Bourdin, 2020).

Thierry Daniel, co-founder of the Paris Cocktail Week – 18-26 January 2019, celebrated in 50 meeting places in Paris – explained that spirit-free means "that there is a real difference between both kinds of cocktails in terms of quality, search for complexity and emotion". "The world has changed, people care for their health. Moreover, the young generations drink less, and sometimes no alcohol at all," he added. These people also include those who adopt a strict dry diet during a defined period, such as the followers of a Dry January (Jeuvrin, 2019). At the Paris Cocktail Week, in January 2020, every bar that participated in this event has been requested to propose to each of its customers one or several cocktails made of the Spirit of Paris, an alcohol-free distillate produced for the occasion by the Distillerie de Paris. "Spirit of Paris is made for those who want to reduce their alcoholic-beverage consumption, or for those who do not drink alcohol, or even for those who have never drunk alcohol," explained Nicolas Julhès, the founder of the Distillerie de Paris. The Spirit of Paris is offered in the form of two recipes: "*Agrumes électriques*" (Highly-Charged Citrus) and "*Boisé stimulant*" (Stimulant Wooded Fragrance), each made of about 20 ingredients kept secret. Before their commercialization by the end of 2020 in groceries and shops belonging to the Julhès company, a few hundred bottles have been distributed in Paris selected bars such as House Garden, in the 11th district of the capital, specialized in making low-alcohol cocktails, called Low ABV. Its owner, Olivier Martinez, is among the bartenders who consider that the spirit-free trend is a new experimental ground and venture. Since his participation in the Paris Cocktail Week, he designed a list of three-spirit free cocktails based on the Spirit of Paris. His last creation has been called *Thé sûr* (Real Tea) and it contains a dose of *Agrumes électriques* blended with rooibos tea infused in water and toasted pineapple during 24 hours: the whole mixture is served on ice with a honey soda and a touch of Himalaya salt (Bourdin, 2020).

Since 2015, in London, under the leadership of Alex Kratena, the bartender-in-chief of the Artesian Hotel, spirit-free cocktails have been made, whereas in Paris Hyacinthe Lescoet had the same approach when, from 2015 to 2017, he was the bartender at the Mary Celeste, in the 3rd district of Paris. At the Combat, in the 19th district of Paris, opened in June 2017, there are only custom-made cocktails. Margot Lecarpentier likes to prepare the "shrubs" – vinegar-based syrups infused with fruits, herbs and spices; she uses whole fruits – skin, pulp and pips – in order to obtain a better concentration of savours and flavours. "Through my approach, I do not aim to systematically reproduce the taste of alcohol, but rather to find a balance of savours," she explained (Jeuvrin, 2019).

It is visually impossible to distinguish a spirit-free cocktail from an alcoholic one. A good example is the Clementine Express created by Nicolas Cruz Mermy at Botanero (3rd district of Paris): this is a spirit-free aperitif that blends gentian, clementine syrup (homemade), yellow lemon, white egg and grated clementine peels; a drink to sip from a small cup, with a creamy texture and full-bodied feeling. With this kind of complex cocktails that play on the bitterness, dryness or the spice, we are very far from the

too sweet *mocktail*, made in a hurry. The word mocktail "was appropriate when the spirit-free cocktail was viewed as a punishment; but it is not anymore valid today with the present upgrading," explained Thierry Daniel. For instance, The Shell, the bar of the Grands Boulevards Hotel, in the 2nd district of Paris, opened in February 2018, proposes a cocktail list that includes (in three equal parts) spirit-free cocktails, slightly-alcoholic cocktails and alcoholic ones. The flagship creation of The Shell is a cocktail consisting of clear water, cucumber juice, lime juice, honey, spices and cured salt. According to The Shell's designer, the number of soda and coffee orders fell down at the bar, while those of spirit-free cocktails rose. Some clients attend the bar with a view to tasting the innovative spirit-free cocktails. On the other hand, among the Low ABV cocktail creations, one could quote the *yoshino* – a real delight consisting of saké, gentian, passion fruit, black lemon and *aquafaba* (chickpea juice). One may wonder whether this new trend of spirit-free cocktails would wipe out the old fashioned *daiquiris* and other *negronis*? Thierry Daniel explained: "One should not oppose the spirit-free and the alcoholic cocktail;" there is a complementarity and one might change his/her drink during the same party or reception." In other words, said Sebastien Jeuvrin (2019), one can drink less, but better.

CONCLUSIONS & EPILOGUE

CONCLUSIONS

When reviewing the multiple facets of eating and drinking, the first focus should be about the means and pragmatic measures aimed at drastically reducing and even eliminating extreme poverty across the world, as well as the starvation of hundreds of millions of people. Some progress has been made, particularly in China and also in Brazil (in a recent period of his political history), but the extremely poor and the poor and all those who survive, lacking food, drinking water, sanitation and shelter, are still with us for many decades. National measures aimed at seriously improving food production and building social protection nets are needed, as well as a global conscience that this struggle against poverty and starvation deserves a top priority on the political agenda of countries and United Nations international agencies. Hunger, besides some external factors like conflicts, wars and forced migrations, often means lack of purchasing power: food is present, but many cannot purchase it. Hence the need to better distribute the national income in order to reduce inequities and their tendency to deepen. In a sense, it is fortunate that efforts are being made in many countries to create a lower middle class that grows steadily. But sub-Saharan Africa is still a matter of serious concern, because poverty and hunger are not receding significantly. Therefore, we should pay more attention to such a situation and obviously take action!

At the beginning of this century, over the last two decades, we have been noticing a wide range of eating habits, that largely reflect the changes in society: low income for some, high for others, inequities in terms of purchasing power of food within the middle classes; harsh competition between brands of foodstuffs and drinks; the wave of the millennials (between 30- to 45-year-old people) with new consumption habits aimed at eating healthier food, drinking less, environment-conscious and ecologically-minded. This wave of change as well as trends or fashions, from the bottom of the societies to the upper wealthy social classes, had a profound impact on the types of foods and drinks available or accessible to the consumers. New phrases were molded: fast food, often also called junk food, street food, organic food and vegan food, and others.

At the same time, we never saw such aggressive advertisement campaigns about drinks and all kinds of food across the world. Some praised the quality of food and preferences when travelling abroad – even ahead of physical and non-physical heritage, although eating habits and culinary traditions are part of the cultural heritage of every nation, country and humankind. But we are amazed by the weight the propaganda regarding food habits throughout the media and across the world. There is one main reason behind that: the big commercial interests of food and beverage manufacturers,

agrifood corporations and food-and-beverage distributors with their multiple brands. Conversely, one cannot miss the emphasis brought to consumers' attention on the close relation between diet – or daily food and beverage intake – and health; and even on the health risks associated with some eating habits. We are very far from the period of lack of knowledge about nutrition and health, we nowadays know much more thanks to evidence from nutrition studies and research over long periods with large samples (cohorts) of persons. We cannot say we do not know, or do follow my culinary tradition or my consuming habits without questioning them, because nutrition science, medicine and health-care are every day bringing in new facts and reasonable recommendations.

But we have to acknowledge that every actor of the food and beverage chain struggles to defend its turf. For instance, multinational corporations, through sponsoring or carrying out their own research, recruiting and paying experts, could influence the results of nutritional studies. But it is difficult to deny deeds. For instance, we notice that the same multinationals or other commercial groups are trying to change their strategies of selling food and beverages. Their advertisement slogan is: less salt, less fat, less sugar, etc. Their big commercial interests, the harsh competition existing between them and the change in consumers' behaviour – regarding the way they buy foods and beverages and consume them – are factors of change. Also, the fast-food industry has changed its menus and is adapting quickly to the change in consumers' eating habits. It remains cheap or very cheap, which is a great advantage for those who belong to the poorer social classes. The beverages are less sweetened, they are not made accessible to children and plain water (mineral or tap) is promoted instead. In other words, the fast food, the sandwich, the kebab are not receding[1], but they try to be different and the commercial constituencies behind them tend to listen much more to the messages delivered by scientific research, the new consumption habits and common sense. They must also listen to the urgent need to reduce their carbon footprint, to eliminate food wastes as well as all kinds of plastic packages, to become environment-friendly, and thus to contribute to decreasing global warming and mitigating climate change. For

1. In this regard, it is worth recalling the story of the world's leading brand of ketchup, manufactured by H.J. Heinz. The company was founded by H.J. Heinz in 1876 in the city of Pittsburgh, United States, where it is still headquartered. Its main business was focused on the commercialization of a sauce of Chinese origin, reconditioned by the American firm. Initially, the sauce called *ké-tsiap*, by the Chinese fishermen, was a mixture of fermented anchovies, pickled in brine, and spices; the British settlers in America eliminated the fish from the sauce progressively and replaced it by tomatoes. In order to improve the conservation of the sauce, Heinz added a lot of sugar and the Tomato ketchup, as we know it today, was born. In 2019-2020, it was estimated that ca. 650 millions flasks bearing the famous logo of the company have been sold annually and across the world (Hardy, 2020).

   In 2013, the Heinz company was bought by the billionaire Warren Buffet for an amount of €21 billion; the corporation supplies 80% of the European market. The number 57 that is pegged on the ketchup bottles or flasks has become a symbol of the brand, to the extent that "Heinz 57" has become part of the English language, designating "everything obtained from a large number of components or of various origins (provenances)" [*Urban Dictionary*]. Since the end of the 19th century, Heinz 57 has been used as a main advertisement of the brand and it was supposed to figure out the number of various sauces commercialized by the company. But at the time, Heinz was already manufacturing 60 distinct products. Therefore, why choosing the figure 57. One of the wide-ranging explanations stated that number 5 was

instance, many food distributors try to sell products, of local provenance and at the right season and thus participate in circular economy, that replaces the lengthy and energy-consuming transportation of foodstuffs.

There are now nutritional yardsticks for public health, and some scientists and experts have even proposed a daily diet that can mitigate the impact of climate change and global warming. This is a diet which drastically reduces the intake of red meat and increases that of vegetables and fruit, dairy products (once a week), nuts and fish; and no more than a glass wine per day – if this can be avoided, better. It is also recommended to reduce the intakes of fats, salt and sugar, in both foodstuffs and beverages. There is also an overall trend of nutritional labeling of foodstuffs, in the simplest way possible, e.g. through colour labels. Obesity, overweight, chronic diseases (e.g. type 2 diabetes), cardiovascular diseases will not disappear at once, but they may recede if one adopts a more balanced daily diet, such as the one suggested above. Fast food or "fake food" will not recede, but the commercial strategies behind it are evolving in order to progressively meet the new consumers' healthier habits.

Street food for those who are in a hurry, at breakfast or lunchtime, can be tasteful and sometimes nutritionally balanced. Not only it is present along the streets and in the squares of Southern and South-Eastern Asia's towns, but also in New York and Europe. Fast food can also be served in similar areas, within the supermarkets and even in a nice and attractive environment. The prices remain reasonable and can be afforded by blue or white collars, as well as by low-income social classes. This is less true for organic foodstuffs which are generally more expensive than those produced by intensive farming and the food industry. Nevertheless, the growth rate of organic food production and sales is amazing. The nutritional advantages are not always scientifically proven, but in general organic products are healthier. But can organic farming feed the world? Certainly not, because the rate of conversion to organic farming is very slow and should comply with many regulations. However, it is part of the solution, along with agro-ecology (e.g. agroforestry).

Vegan food, although representing a tiny proportion of foodstuff consumption – except in certain communities who are rightly concerned about animal well-being and the way domestic animals are slaughtered –, provides some solutions in order to break

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the lucky-charm figure of H.J. Heinz and number 7 was that of his wife. But in 2018, during an exhibition devoted to the brand, the person in charge of that exhibition stated that this interpretation was meaningless. H.J. Heinz would have chosen this number by chance after being inspired by an advertisement that praised the 21 different pairs of shoes manufactured by a shoe brand (Hardy, 2020).

Another funny aspect of the Heinz ketchup story has been the role of the British artist Ed Sheeran, who was so addicted to consuming ketchup daily and one bottle or flask a week, that an advertisement of the brand was tatooed on his biceps. In 2019, the artist appeared in an advertisement of the brand, pouring ketchup on his meal in a gastronomic restaurant, under the eyes of stunned waiters. It seems that the British singer did really follow what the advertisement suggested; his collaboration with Heinz has been pursued and in 2019 a bottle of ketchup was christened "Tomato Edchup," during the national day of the ketchup – celebrated in the United States on the 5th of June. A limited series of 150 flasks, the design of which has been inspired by the artist's tattoos, was commercialized at a price of US$1,300 to US$1,800 for the benefit of charity organizations (Hardy, 2020).

the dependence on all kinds of meats and to replace them with plant proteins[2]. All the beliefs and suggestions of the vegan-food addicted persons are not accepted by a large part of the population in many countries. But this agreement or disagreement should not hide the part of truth in these beliefs and proposals, e.g. the ethical and philosophical issues regarding the well-being of domestic animals and their slaughter conditions for human consumption. The latter issue is obviously raised when animals are slaughtered according to religious rules, e.g. in Judaism and Islam. Halal meat is also acknowledging an important growth rate, particularly in the European countries which have received several waves of immigrants, many of them being Muslims. The trend towards a more rigorous Islam and the respect of religious precepts and rules also explains this growth rate. Halal tourism is another reason: Muslim tourists, especially coming from the Gulf countries, Malaysia, Indonesia, and others, are looking for this kind of food. This overall trend is at the opposite of the vegan trend, because it deals with the consumption of meat and poultry derived from animals slaughtered according to religious rules – not necessarily meaning a lack of satisfactory hygiene conditions and measures to reduce the suffering of animals.

Another fast-growing sector, in connection with changing eating and drinking habits, is the delivery at home of prepared meals at any time of the day. This can respond to those who do not want to cook their food or are too busy to do so. And these are numerous in societies where female labour is expanding and wives or lonely women prefer to rely on effective food-delivery companies. One generally deals with fast food or improved fast food, or Asian culinary preparations. A subsector is also growing quickly: the delivery of specialized diets aimed at counteracting overweight or obesity in developed countries. An aggressive propaganda, particularly on television screens and through the social networks, helps to expand this subsector. This is certainly a promising prospect, despite the problems associated with the rather appalling working conditions of the deliverers – most often cyclists.

On the gastronomic side, there has been over the last three decades a marked trend of mixing or blending culinary traditions, particularly under the influence of Asian cuisines. This multiculturalism is set to last, because, as mentioned earlier, culinary traditions are changing in order to adapt to their social environment and to adopt other ways of cooking and eating; because they are part of the culture of any nation, which often changes from one generation to the other. This multiculturalism in food and drinking habits does not mean that traditional cuisines or gastronomic creativity are erased. But they could be combined without losing their identity. Many examples of this trend have been described (see pp. 183-207), as well as some trendy and surprising eating

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2. In November 2020, Burger King in association with the Dutch company Vegetarian Butcher – specialized in the production of "veg. meat" – commercialized a 100% vegetarian sandwich, called "Vegetarian Whopper" in Morocco, Saudi Arabia and the United Arab Emirates. The sandwich contains 0% meat but it tastes like meat. It is made of a grilled-wheat pancake, garnished with freshly cut tomatoes and lettuce, creamy mayonnaise, ketchup, gherkins and sliced white onions. This Vegetarian Whopper, sold at *ca*. US$4 in Morocco, could attract many consumers who do not want to eat meat and may trigger another revolution in the fast-food industry.

experiences. How would gastronomy evolve in the future, when raw-food eating is appealing and when we see the high-tech burger encroachment. It seems that there is no real danger, because the talented chefs – who often receive many awards – adapt and develop their creativity in order to keep gastronomy attractive. Some of them have even decided to abandon their "stars" and higher rankings and to move towards simpler recipes, but still appetizing, less expensive and which still deserve the qualification of gastronomy.

Parts two and three of the book deal with food ingredients and beverages – alcoholic and non-alcoholic. The choice is arbitrary and it aims to illustrate what is needed and what is tasteful – pleasing the palate, without necessarily being good for health, e.g. sugar, fats, seafood, etc.). Tea, cacao (cocoa) and chocolate, beers and wines are widely consumed across the world and they play an important economic role in the producing countries. Finally, it was also worth recording old cocktails – blending or assembling spirits, herbs, spices, in order to obtain different savours and flavours, like in gastronomy or in mixing culinary traditions. These cocktails are still popular, along with new ones like the Italian vermouths and the Scotch and American whiskeys. Ending on this tone clearly means that, with food and beverage consumption, we are dealing with several cultural facets, including culinary traditions, blending and mixing cuisines, immigrants' contribution. But all these facets must increasingly interact with scientifically-based nutritional recommendations aimed at protecting health and the environment.

EPILOGUE

This book has been drafted before the global pandemic caused by a new very contagious and often lethal coronavirus, SARS-CoV-2; the pandemic is called Covid-19. Its main symptom, like two other coronaviruses – SARS and MERS – is a severe acute respiratory syndrome (Sars), i.e. pneumopathologies and lung lesions. By the end of 2019, the first outbreak of the virus occurred in the Chinese province of Hubei (centre of China) and in its main city Wuhan (*ca*. 11 million inhabitants), located along the Yangzi Jiang, the longest river of China known as the Blue River. During the following months (2020) the virus spread throughout the world, heavily affecting Western Europe, North and South America. Despite a quick identification of the virus structure and the sequencing of its genome – it is an RNA virus –, there was no available vaccine or medical treatment. Artificial respiration and ventilation of the patient's lungs in intensive-care units, accompanied by sedative medicines, was the only way to treat severely infected patients (especially senior people). Most of the young people who develop the symptoms of the virus attack, were treated with painkilling and sometimes antipyretic medicines, and, if necessary, assisted with oxygen respiration.

By August 2020, several candidate vaccines and treatments were being tested in China, the United States and Europe. Also tests to identify the presence of the virus in the patients' bodies were available – i.e. based on the detection of the viral genome in the nasopharyngeal mucosa –, but they had to be produced on a much larger scale. Also serological tests were produced by the big pharmas in order to detect the presence in the patient's bloodstream of antibodies against the virus – a drop of blood is sufficient to make the test. The first effective vaccines against the SARS-CoV-2 may become available by the end of 2020 and in 202; they will be manufactured in very large quantities by the big pharmas, after having been tested through authorized accelerated trials and in full compliance with international standardized regulations.

In the meantime, and following the advice of scientists and physicians, the government authorities had to rely on the only way to slow the dissemination of the virus: enforcing the rules of confinement of the population, while at the same time recommending the need to adopt hygienic behaviours – such as washing hands with soap several times a day or using hydroalcoholic gels –, and physical distancing – requesting everybody to distance oneself from another person by at least two meters; for instance, when attending the few places that were kept open, such as pharmacies, supermarkets and groceries for food purchases. These confinement or lockdown measures were not taken at the same time or speed by the various countries, as each of them was

evaluating the epidemiological situation, has closed its borders and forbidden air transnational transport. Countries like Italy, Spain and France, for instance, did not react immediately and were therefore more severely hit by the pandemic. This situation has overwhelmed their health-care systems and particularly their intensive-care units which had not enough human and material resources – e.g. masks, coats and scrubs, and reagents to make the virus-detection tests, all of them in very large quantities. Other countries were apparently more reactive, such as the Scandinavian countries and Germany, whereas political controversies in some countries resulted in delayed decisions and a heavier death toll of the Covid-19.

Geographical distribution of the Covid-19 pandemic

At the end of September 2020, the World Health Organization (WHO) statistics and other sources (such as Johns Hopkins University, Baltimore, United States) showed that more than 1 million deaths caused by the Covid-19 had been recorded. *Ca*. 278,000 new cases of infection have been recorded in the world, during the second week of September 2020. India has registered a daily number of new Covid-19 cases amounting to 97,894 – a world record. The WHO therefore concluded that the pandemic was even spreading worldwide. In June 2020, the distribution of deaths due to the Covid-19 was (in percentage): 32.3% in South America, 32% in North America, 18.1% in Asia, 13.3% Europe and 4.2% in Africa. At the beginning of July 2020, 4,891 deaths per day had been recorded in the world; this was an average figure calculated between 25 June and 1 July 2020. The respective figures were 1,006 deaths per day in Brazil (after a peak of 7,204 deaths per day between 10 April and 22 April 2020), 169 in Chile, 183 in Peru, 648 in Mexico, 915 in the United States, 115 in the United Kingdom, 295 in the rest of Europe, 418 in India, 548 in the rest of Asia and 221 in Africa. These figures withdrawn from WHO statistics were in some cases underestimated, so that the death toll must be higher (Pineau, 2020).

Regarding the United States, a record number of more than 57,000 new contaminations in 24 hours had been reached on 3 July 2020, according to the record-setting of Johns Hopkins University in Baltimore. Anthony Fauci, the director of the National Institute of Allergy and Infectious Diseases (National Institutes of Health, NIH, Bethesda, Maryland), stated that this figure might jump to 200,000 new contaminations per day if "the pandemic trend were not reversed". Half of these new cases were recorded in four American States: California, Arizona, Texas and Florida (Pineau, 2020). By the end of September 2020, the total number of persons infected with the SARS-CoV-2 reached *ca*. 6.6 millions in the United States – the world's most affected country, followed by India with ca. 5.1 million cases. Some experts predicted a death toll of over 300,000 by the end of 2020 (compared with more than 270,000 by the end of November 2020). The United States have been therefore heavily affected by the pandemics and there was a general consensus on the mismanagement of the sanitary crisis at the federal level, despite a technically advanced health system (Lesnes, 2020).

The Latin America and Caribbean region has been, in a short time, very affected by the pandemic: *ca*. 6 million people contaminated with the coronavirus and more

than 230,000 deaths. The PanAmerican Health Organization warned that the death toll would be higher than 400,000 between July and October 2020, in the absence of stricter sanitary measures, especially during the Southern Hemisphere winter – a season during which the coronavirus might spread widely (Chaparro, 2020; Lesnes, 2020; Pineau, 2020; Saliba, 2020). Brazil, Mexico and Peru were the most affected countries. But Chile had the highest rate of cases per million inhabitants: 20,200 cases, compared with 18,780 in Panama, 15,600 in Peru and 15,390 in Brazil (Chaparro et al., 2020).

The comparison among the Latin American countries is far from being accurate, "because they do not perform the same tests and in the same proportions," explained Ciro Maguiña Vargas, an infection specialist and professor at the Cayetano Heredia University in Lima. For instance, "Peru is performing tests much more than its neighbours, but these are rapid serological tests which indicate the presence of antibodies against the virus in the bloodstream, but not the existence of virus particles. Molecular tests based on the polymerase-chain reaction or PCR that detect the presence of the virus in the nasopharyngeal mucosae are much more performed in Chile; these tests are more reliable, but in Peru it is almost impossible to dispatch them to the remote and landlocked regions of the country," he added. Argentina, of which the capital Buenos Aires has been locked down since the 20th of March 2020, had an unprecedented number of persons infected with the coronavirus on the 13th of August 2020 – 7,498, and 149 deaths, for a total of more than 276,000 infected persons and more than 5,300 deaths in the country. In Colombia, the spread of the virus across the country was still going on by the end of August 2020: a total of 433,000 infected persons – 10,000 new cases were recorded daily – and 14,000 deaths for a population of 50 million inhabitants. In Mexico, by the end of August 2020, the number of deaths reached more than 60,000, the number of infected persons with the coronavirus being higher than half a million (560,164) [Chaparro et al., 2020].

The PanAmerican Health Organization specialist, Carissa Etienne, stated on 11 August 2020 that the coronavirus propagation in Latin America was increasing the risk of being contaminated with, or suffering from, mosquito-transmitted diseases such as dengue or malaria; the impact of these diseases "is disproportionately high among poor and vulnerable populations," particularly in the autochthonous communities. She deplored that "while we were obtaining significant results in the control of tropical diseases such as filariasis or schistosomiasis (bilharziosis), the Covid-19 has resulted in holding to a standstill the massive campaigns of drug distribution." She also indicated that, due to the pandemic, "80% of the Latin America region had difficulties in the delivery of treatments against tuberculosis; that also 30% of AIDS patients were not consulting their medical doctors; the detection of hepatitis was more difficult to carry out in one-third of the countries … and patients were dying because they could not have access to their treatment of chronic diseases" (Chaparro et al., 2020).

In Brazil, the chaotic management of the Covid-19 has resulted in a heavy death toll: more than 105,000 and this information made the headlines of the main Brazilian newspapers, including *O Globo* and *Folha de São Paulo*. According to Gulnar Azevedo

e Silva, a professor of epidemiology at the University of Rio de Janeiro Institute of Social Medicine, "a significant proportion of this death toll – *ca*. 180,000 recorded by early December 2020 – could have been avoided thanks to an integrated policy between the local communities and the Federal State, that aimed to explain to the whole population what to do to block the propagation of the virus. Instead, we have a president who denies the gravity of the coronavirus and is opposed to the lockdown or quarantine of infected patients, and is praising the efficiency of chloroquine – the "wonder drug". The official number of contaminations – most probably underestimated – is higher than 4 millions in a country of 210 million inhabitants (Vigna, 2020).

In Peru, on 13 August 2020, health authorities announced that more than half a million infected persons have been recorded and more than 25,000 deaths have occured; i.e. 800 deaths per million inhabitants. Peru was therefore the world's second country is terms of deaths per million inhabitants, just behind Belgium (866) and ahead of the United Kingdom (703) and Spain (611). Peru has become the third country in Latin America in terms of death toll due to Covid-19, behind Brazil and Mexico. But in terms of the number of deaths calculated for the country's population, Peru was unfortunately at the top. In an endeavour toward transparency, the health minister, Pilar Mazzetti, warned that the death toll due to the coronavirus might be higher than 44,000, i.e. 1,370 deaths per million inhabitants and a mortality rate of 8% (Chaparro et al., 2020).

Regarding Asia, the WHO announced that a team will travel to China during the second week of July in order to investigate how this coronavirus emerged in December 2019. In China, after choking the spread of the SARS-CoV-2 in the city of Wuhan, the Chinese health authorities were fighting the virus in the capital Beijing at the beginning of July 2020. More than 11 million persons have been tested to detect the presence of the virus – i.e. almost half of the total population of the town; and more then 5,000 persons working or living near the wholesale food market of Xinfadi, ubicated in the southwest of the capital, have been isolated during four weeks. The health authorities did not choose the drastic lockdown measures they imposed on Wuhan's dwellers. On 9 July 2020, the Chinese authorities stated that, at the national level and since the end of 2019, 83,585 cases of coronavirus infections have been detected in mainland China, and 342 patients among them were still under therapy; and that 4,634 persons passed away, mainly in the Hubei province (Lemaître, 2020). There have been many arguments about these figures and several experts suggested that the number of deaths was underestimated.

Similarly, the South-Korean authorities who were able to marshall the first wave of the virus through implementing a massive strategy of viral tests and traceing of the persons in contact with infected patients, informed by the end of June 2020 that they had been struggling since mid-May 2020 against "a second wave of the coronavirus contamination" with 35 to 50 new cases recorded everyday, mainly in Seoul and its region. Physical distanciation had been imposed by the end of May 2020 and, since then, the situation was under control (Pineau, 2020). Conversely, in South Asia – where almost a quarter of the world population is living – the propagation of the virus continued to spread and the situation was becoming alarming. India is the world's second country to be affected, behind the United States: 5.1 million cases

of infected people across the country by the end of September 2020. The pandemic is also heavily present in Pakistan (221,000 cases) and Bangladesh (156,000 cases), where the governments concerned were lifting the lockdown measures so as to help the economic recovery (Pineau, 2020).

In Europe, where more than 200,000 persons passed away because of the coronavirus, the most affected countries by the pandemic were the United Kingdom with 63,179 deaths recorded by early December 2020 and since the end of 2019; Italy with 62,626 deaths; France with *ca*. 56,940 deaths by early December 2020; Spain with 47,344 deaths; and Belgium with 17,692 deaths. Since the beginning of the pandemic, the European Centre for Disease Prevention and Control has recorded *ca*. 3 million people infected with the virus throughout Europe. Due to the emergence of new disease clusters, Germany, Portugal and the United Kingdom have also decided to lockdown part of their populations. A real and scaring second wave of the virus has occurred since October 2020, after antilockdown measures have been implemented earlier in some countries and the European Union opened its borders to a dozen countries (excluding the United States, Brazil, Israel and to some extent China, among others). According to Antoine Flahault, a public health professor and director of the Institute of Global Health at the University of Geneva, "second waves of the pandemic can be seen in Israel, Algeria, Djbouti and Saudi Arabia. …". "During the coming summer, there may be a respite of the pandemic, if the new disease clusters could be controlled. Conversely, a new wave of the pandemic during the forthcoming fall and winter is most likely," he added. Such a likelihood is supported by the fact that "the available serological and epidemiological studies show that collective immunity is still low," recalled the European Centre for Disease Prevention and Control (Pineau, 2020). In fact, this is what has happened since early October 2020 in most European countries.

European epidemiologists are scrutinizing the Covid-19 situation in Australia and New Zealand, that have closed their frontiers to foreign visitors (till July 2020). The New Zealand government has been able to marshall the first stage of the pandemic, in Australia, there has been new disease clusters in the last weeks of June 2020 – there have been 8,000 infected cases recorded, of which 104 died in Australia. However, the fear of a second wave of the pandemic has led the health authorities to lockdown more than 300,000 dwellers in the northern suburbs of Melbourne, Victoria (Pineau, 2020). In the case of several pandemics, it has been observed that the first wave was not necessarily the most daunting one. That was the case of the 1918 so-called Spanish flu, or the "Hong Kong flu" in 1968-1970; "the first wave was ringing the bell and, in the case of Europe, it resulted in 15% to 20% of morbidity and mortality," said A. Flahault, because the collective immunity induced by the first wave of the pandemic was quite low (Pineau, 2020).

The SARS-CoV-2 did not spread throughout Africa with the same impact as in other continents, although some experts think that the peak of the pandemic is still to come. On 2 July 2020, 400,000 infected persons and 10,000 deaths have been recorded by the African Disease Control and Prevention Centre. South Africa seemed to be the most affected country with one-third of the contaminations and one-fourth of the deaths.

"Even though they are not considered as risk factors *per se*, there is a very scaring association with HIV infection and tuberculosis. Heath systems are already fighting both diseases for a long time and are therefore deprived of new resources to control the corona virus pandemic," stated François Dabis, an epidemiologist and director of the French National Agency for Research on AIDS and Viral Hepatitis (Pineau, 2020).

The exceptional situation created by the pandemic – sanitary, social and economic – has fostered an extraordinary commitment of public, private and non-governmental institutions. For instance, the Bill & Melinda Gates Foundation allocated US$1.6 billion or €1.4 billion over five years to the Global Alliance for Vaccine Initiative (GAVI); during the Vaccination World Summit (at the World Health Organization) *ca*. US$8.8 billion or €7.7 billion have been pledged with a view to supporting research-and-development on the discovery of effective vaccines against the viral disease. In addition, several billions of dollars or euros have been devoted to the same purpose by many big pharmas and several biotechnological startups associated with them.

It is true that the enforcement of *very strict* lockdown measures in the city of Wuhan – i.e. persons remaining at home and receiving their meals at the gate of the building of their residence, and later on authorizing one person per family to leave home for purchasing basic foodstuffs – seemed to pay off. Therefore, by early April 2020, the lockdown measures were progressively lifted and a limited number of people (tested Covid-19 negative) could walk off home and even move to their working place. Since May 2020, a similar approach has been progressively adopted in the Western countries, when the peak of the pandemic has been flattened. Their whole health-care system has been shattered and public and private hospitals have been submerged by an increasing number of patients severely affected that had to be attended in intensive-care units for at least three weeks.

The pandemic did cause a profound health-care crisis and all countries, with a few exceptions, were going through very difficult times. Not to speak about Africa and other developing countries that will suffer more because of major deficiencies in their health-care systems. They can even become endemic grounds of the virus, that may invade again the recovering industrialized countries. Henceforth the absolute need for international cooperation. During the pandemic and once it is over, it is likely that massive investments will be made in most countries to upgrade the health-care system, including a large-scale recruitment of physicians and nurses – much better paid – with a view to better facing pandemics or infectious-disease epidemic outbreaks in the future.

Other impacts of the pandemic

But the crisis was not only a sanitary one, it is also an economic, social and financial crisis (see pp. 21-30). Almost all the economic sectors were hit because of the lockdown measures; those who could work at home with the help of their computers and sophisticated communication systems have adjusted their work schedule; but there were many workers or craftsmen, including farmers, supermarket cashiers, and of course all the medical staff, that had to attend their working place – sometimes

with little protection in terms of masks and gloves. The overall result was a profound economic recession, as well as a massive increase in the countries' external debt. Such an exceptional situation has, once again, highlighted the social inequities that ought to be reduced[1]. For instance, all those belonging to the lower social categories, who helped the countries to keep their basic supplies, e.g. in the areas of health-care, food, energy, waste collection, must have the full recognition of the state through improving their living conditions.

No wonder that, during this unprecedented lockdown period, one could observe significant or major changes in people's eating habits and consumer's purchasing behaviour, such as:

- more cooking at home and, for those who can afford it, buying more fresh produce (vegetables and fruit), due to the closing down of all fast-food restaurants, kebab and sandwich shops, street-food trucks, and the drastic decrease in the delivery of prepared meals at home;
- more organic-foodstuff consumption;
- soaring of drive-in food delivery, i.e. ordering food online and later on collecting the items in one's car in a parking lot near the supermarket;
- more circular economy, the farmers selling their produce directly to the consumers or to authorized food markets, especially in small towns or villages;
- eating more fish than red meat, because fish was cheaper due to dwindling fisheries;
- better distribution of work within the household, particularly among white collars, and concerning the preparation and cooking of meals;
- overpurchase of foods – especially the basic foodstuffs that can be stored, like rice, oil, pasta, or toilet amenities, because people were afraid of a possible breakdown in the supply chain; but after a week or so, food purchases went back to normal, people realizing that the supply was good; sometimes specific brands were replaced by others;
- a lack of humanpower in the fields, farmers needing more hands to pick up the spring crops, such as, for instance, asparagus and strawberries in France and elsewhere in Europe.

After the health crisis, some of the above-mentioned changes may remain, like cooking more raw and fresh produce at home; but fast and street food will come back, as well as the delivery of prepared meals at home. It is worth noting that during the lockdown period, many cafés and restaurants made several arrangements to deliver light meals and beverages almost at their doorsill. That was aimed at minimizing the heavy loss in their turnover. But no meals were served inside the premises. Regarding

1. In France, for example, the charity organizations have estimated that because of the sanitary crisis 1 million new poor have been added to the 9.3 million French people already living under the threshold of poverty, i.e. in financial terms below €1,063 per month and per consumption unit; this figure included 14,8% of French households in 2018, according to official statistics.

the gastronomic approach to eating habits, the closing down of renowned restaurants across the world, i.e. those which are ranked among the World 50 Best Restaurants and which have been awarded one or more Michelin stars, probably had the merit to give the chefs a time of thinking about their profession – a moment of introspection which they never had quite often before. The end result of this reflection seems to be the emergence of what is called "flexibility", and this happened mainly among the restaurants located in the urban environment. That means, for instance, that the Danish restaurant Noma – four times designated as the world's best restaurant – started to serve burgers costing €16 each, when it opened on 18 May 2020 after several weeks of lockdown. That was a sign of making more flexible the gastronomic dogma; in the case of Noma, it used to serve a unique menu, complex and experimental, costing €350 per person. Matt Orlando, the chef of another renowned Danish restaurant, Amass in Copenhagen, explained: "It is most likely that 30% to 40% of the restaurants will disappear by February 2021. Borders are closed down and there is not a sufficient number of Danes to attend all the present restaurants. In order to survive, one must please the locals and reach the highest number of them." Julien Royer, the French chef whose restaurant named Odette, located in Singapore and which has been awarded three stars of the Michelin, has predicted "the end of the very long tasting menu and, conversely, the increase in meal offers giving the customers more choice, while keeping the proper standards of our eating places." In Paris, the chef David Toutain has replaced his dinner-menu costing €250 by a wide-ranging à la carte menu, where one can find a €76-take away meal, but also cheaper dishes, costing €6 each. He explained: "My clients included 60% of French people. One should try to bring back every month or week those customers who used to come to the restaurant once a year." On the other side of the globe, in San Francisco, for instance, the chef Dominique Crenn followed the same approach. In his four-star restaurants the clients can buy €30-take-away dishes – while those who were unscathed by the Covid-19 pandemic could still choose to pay €315 for a 14-stage menu. In Tokyo, the German chef Thomas Frebel was ready to open his two-star Inua restaurant by the end of May 2020, and to give his clients the choice between a gastronomic menu (with eight dishes) and cheaper meals eaten in a canteen (without reservation) adjacent to a bar lounge (Von Bardeleben, 2020).

However, this flexibility approach was regarded differently by renowned restaurants ubicated rather far from the city centres or in the rural environment. Most of these restaurants will probably remain "destinations", as defined since 1936 by the Michelin: gastronomes travel to these three-star restaurants in order to taste "an exceptional or outstanding cuisine that deserves the journey." Similarly, at the restaurant Mirazur, located at the French-Italian boarder, in Menton, "the clients do not come to just eat, but to have a life experience; I must be up to their expectations," explained his chef Mauro Colagreco. Mirazur won the title of the world's best restaurant, it was awarded three Michelin stars in 2019 and it was expecting a wave of locals to fill in the spaces after its reopening. In this perspective, the chef has been trying to discover ways and means to make the meals served at the Mirazur a memorable experience (Van Bardeleben, 2020). Elvire Von Bardeleben (2020), a gastronomic critic of the French daily newspaper *Le Monde*, explained that whatever their choice – to become more flexible in their offer or

deepen their working methods in order to reach perfection – the renowned restaurants across the world that have been strongly hit by the Covid-19 pandemic, have a unique opportunity to get rid of the bad habits imposed on them by the routine and to think of whom they target and how to do it. The World 50-Best-Restaurants institution has decided not to designate its 2020 ranking which was nevertheless ready. Because "it is not the right time to celebrate when several restaurants are struggling to survive and not go bankrupt," stated Hélène Pietrini, the director of the international-ranking institution. It is also far from certain that there will be a ranking in 2021 and also that there will be enough substance for the Michelin new guide to be published in January 2021. In this regard, Matt Orlando, the chef of the Danish restaurant Amass, stated that "it was about time for the profession to make a pause and to stop the overbidding and media advertising as well as the race for the "like" on Instagram." In the same wane, David Toutain commented: "I do not want to think anymore of the gastronomic guides and stars. I just want to cook, to go back to basics and to ensure my business' survival." That seemed to be good intentions, because what will take the restaurants out of the crisis are not the international rankings, but their committed clients (Von Bardeleben, 2020).

On the other hand, important changes ought to be made in order to improve the conditions of poor and lower-class people, recognizing their contribution to a country's whole economy and increasing their wages accordingly. In the developing world, lockdown measures following the coronavirus pandemic were not easy to enforce because of the housing conditions and the huge area of slums around the big overcrowded towns. Unfortunately, the lack of sufficient food, undernutrition, malnutrition and even starvation will still prevail, especially in sub-Saharan Africa. Henceforth, the primary importance of food-aid and health-care cooperation – a fundamental goal of the Global Health Programme, promoted by the Bill and Melinda Gates Foundation.

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About the book

When briefly reviewing the multiple facets of eating and drinking across the world, one cannot refrain from recalling that the primary goal and top priority of our civilization are to eliminate extreme poverty and starvation still prevailing among several hundreds of millions of people. In 2019-2020, this situation has worsened due to the Covid-19 pandemic; the latter has created the so-called "new poor" in many countries. Also the pandemic has caused significant changes in people's eating habits and consumers' purchasing behaviours.

Over the last two decades, we have noticed the emergence of a wide range of eating habits that largely reflect societal changes; as well as the setting up of business strategies of large agrifood multinationals and big food distributors. This dual movement has led to the qualification of food as fast food – often called junk food –, street food, slow food, organic and vegan food... At the same time, aggressive advertisement and communication campaigns all across the world praised these kinds of food.

Albeit more recent than the above-mentioned trends, nutritional and medical research brought in evidence of the close relationships between eating and drinking habits and health, including health risks. Consumers' approach to choosing healthier food explains the sustained growth rate of organic food and, to a minor extent, that of the vegan movement. Likewise, the business strategies of agrifood multinationals and big food distributors are trying to meet the consumers' concerns about their health and environment protection. Regarding vegan-food eaters, they are disrupting the societal scenario. Even though they are a very small proportion of consumers, the prohibition of food ingredients of animal origin in their diets has shed a new light on our perception of animal well-being. The subsequent philosophical and ethical considerations should not be underestimated, because they call for a societal change regarding the way we look at our domestic animals.

On the gastronomic side, we have witnessed and we are still seeing a marked trend of blending culinary traditions. This multiculturalism of cuisines is set to last; it does mean mutual enrichment, and the extraordinary migrations across the world as well as the amazing expansion of tourism play a very significant role.

Parts two and three, of the book, deal with food ingredients and beverages. The choice of both is arbitrary and just aims to illustrate what is needed for a healthy diet and also what pleases the palate. Moderation is strongly recommended when drinking alcoholic beverages. Here also the art of assembling and mixing plays a key role, as well as the creativity of those inventing cocktails. Once again, we are dealing with social and cultural traditions, trends, fashions and creativity, while at the same time respecting the science-based nutritional recommendations, as well as their implications for environment protection.

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