1. From Breeding & Feeding to Medicalization, an introduction[3]

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Contemporary developments in animal husbandry are worrying on many counts. They are of several orders but call into question our way of life, our health, our ability to control our development, and finally our relationships with others species. Among the most important problems that breeding raises are the imbalance of human diet, global warming, deforestation, eutrophication of stream, lakes, and seashores, antibiotic resistance, animal welfare, zoonosis to stick to the most obvious and the most critical.

These questions are not new. As early as the 1950s, the first concerns on the potential dangers of antibiotic resistance were issued in various countries (Kirchelle 2018 and 2020). Moreover, with antibiotics, we can considered that, since the 1950s onward, breeding participates to what Jarrige and Le Roux called *The contamination of the Earth* (see Le Roux and Jarrige 2020).The question of animal well-being was posed by Ruth Harrison in the early 1960s (Harrison 1964)[4].

Questions about the climatic effect of breeding, which will be not devise in this book, are more recent. But as soon as the question of global warming emerged during the 1970s and 1980s, the role of livestock in this process was raised from at least two points of view: that of gas emissions from ruminants, and that of deforestation linked to the extension of pastures in certain tropical countries (Henderson-Sellers 1981; Fearnside 1983, 1985) [5]. Beyond the extension of pastures, we should also mention the extension of crops intended to produce food for intensive livestock farming.

It is useless to multiply the examples, but it is impossible not to evoke the present day. While the possibility of disease transmission from animals to humans has been well identified for over a century, particularly with the issue of tuberculosis, the term zoonosis has become familiar to many of us since the mad cow crisis in the middle of the 1990s[6], and the bird flu and the famous H5N1 virus during the 2000s. Current events have demonstrated to what extent our societies could be weakened by the eruption of a virus, whose origin is certainly still debated, but which could come from a wild animal. This issue will not devise in this book, but it is worth noting here that the animal origin of most of our diseases and the role of the promiscuity of humans and livestock and the contact with wild animals since the Neolithic era in the process of emergence of new human diseases are no longer debated (WHO 1959; Fiennes

[3] This book is the result of a two workshop organised, in Santiago de Compostela (2018) and Uppsala (2019), as part of the CNRS GRDI-AAA (2016-2019). HISTAGRA Research Group. University of Santiago de Compostela (USC).

[4] But long before that, Upton Sinclair had denounced in The Jungle, the hell of the meat-packing industry for men but also for pigs.

[5] The FAO estimated that breeding is responsible for 14.5 % of the greenhouse gas (FAO). About the global estimation of the greenhouse gas emission by cattle breeding in Brasil, whose herd is by far one of the most important in the world, see Bustamante and al. 2012 and Cardoso and al. 2016. In this case not only deforestation releases carbon dioxide, but grazing (including biomass burning after deforestation) favour releases of methane (entheric fermentation) and nitrous oxide (deposit of animal excreta on pasture). Nevertheless, as we see below, the shift from grazing to more intensive animal husbandry raises also a lot of issue.

[6] For the importance of mad cow crisis to the implementation of precaution principle in Europe and bibliography about this issue, see in this volume the chapter of Nordeus.

1978, Hardy 2003)[7]. But now it is the multiplication and the dimensions of potential infection sites since the industrialization of livestock farming that are worrying[8].

Finally, to evoke a last issue that will not be devise in the book, it can be also noted that the directly or indirectly production of meat, dairy products, etc. account for a large (and increasing) share in the virtual water flow (see Duarte, Pinilla and Serrano 2019).

Apart questions evoked previously, this book intends focus specifically to some aspect of the evolution of breedings in western Europe. If there is no shortage of historical work on livestock farming, we believe in the need for rural historians (but also for historians as a whole) to consider this question in a multidisciplinary light. This is the aim of this volume. The ambition of this book is therefore both: to shed light on the question of the evolution of animal husbandry and to provide readers with a multiplicity of reading grids which will enable them to apprehend a wide range of methods and of questions. It is therefore a history book but it is also a little more than that.

This book covers a period of time from the end of the 19th century to the beginning of the 21st century, a period of 150-180 years. It also covers several Western European countries (Spain, Italy, France, United Kingdom, The Netherlands, and Sweden). It does not therefore claim to be exhaustive, but it allows us to consider a wide range of contrasting situations and development paths for livestock breeding between the end of the 19th century and the beginning of the 21st century. The authors consider questions dealing with scientification/industrialization of animal husbandry according to several dominant axes across a wide range of national situations. It traces the contributions of different sciences related to animal husbandry while maintaining a critical distance from these contributions. It is not a question of telling a "success-story" but of proposing a grid for reading the progress/evolution/danger of breeding which takes into account the successes, but also the dangers concealed by the progressive submission of breeding practices to science and to industry.

Furthermore, light is shed on the roles of some professions, especially veterinarians but also agronomists, geneticists, technicians, and other experts, who focused on their specific field, without always being aware of the outcome when the pieces of the puzzle were put together, such as animal well-being, stress on farmers, or consumer critics. The roles and work by veterinarians are paid attention in several chapters, not only as scientists, but as a corporative profession, with their own interests and relationships (market, enterprises, official public bodies, peasants - breeders associations) all over the cattle improvement process. Moreover, the veterinarians had relationships to consumers/culture of consumption and animal health, environment, and food safety.

In order to fulfill the objective that the editors of the book had set themselves, it has been necessary to invite a wide range of skills, such as: agrarian and livestock history; economic history; history of science; microbiological science; sociology, and veterinary

[7] See also Morse (1995); Pierce-Duvet (2006), and the short but usefull text of Hart, Bennett and Begon (1999). It is also valuable to devise anthropologistic approaches of zoonoses which allow us to reinterroge relations between human and non-human worlds. Among others see Levi-Strauss (2001) and Lynteris (2017; 2020, 42-76).
[8] Nevertheless, it is important to point that there exist a lot of sites and a lot of human activities that could favour the emergence of new zoonoses. Industrial breeding sites are one of them, not necessarily the most important per se. But domestic animals as intermediate hosts, and intensive animal farming as reservoir and as device to spread new threats are particularly efficient.

medicine, to varying degree dealt with via the authors disciplinary and transdisciplinary insights.

The book invites various reading grids, such as chronological approach, type of knowledge, or type of breeding. A chronological approach will make it possible to account for the process of implementing an increasingly techno-scientific approach to animal husbandry. Gradually, or with leaps, the different stages of the activity are invested by scientific discourses: food, reproduction/selection, fight against epizootics, and etcetera. But a strict chronological approach would ignore precisely what makes chronology: the fact that regions (or countries), sectors, types of livestock rearing, do not advance at the same pace.

An approach by type of activities would not be possible for at least two reasons: lack of space and the fact that issues could more or less become common to different sectors, even if they did not initially take the same path and if they did not go at the same pace. The use of antibiotics, which shall be evoked by several chapters is typical. Finally, all sectors had to take into account the increasing use of antibiotics. But we are not only moving from a pre-antibiotic world to a world where antibiotics are ubiquitous. The picture is more complicate. If in certain countries the resistances are perennial, antibiotics end up being one of the structuring elements of the whole sector, not only in Western Europe and in the USA, but also in the Soviet block and later in the countries with low and middle income (Kirchelle 2018),[9] and not only in countries that used them massively, but also in countries that try to resist or to implement regulation, as Great Britain, or Sweden.

Adopting an approach by type of knowledge implies relying on the expertise of a multitude of scientists who will claim either preeminence or sovereignty over a particular field of knowledge. We then risk having a superimposition of knowledge that are more or less (rather more than less) foreign to each other. But, more important, an approach based on knowledge would ignore that knowledge is contingent or, at least, that it is changing. Delphine Berdah (Berdah 2012, 2020), has clearly shown how much French veterinary knowledge, and the place of French veterinarians themselves, have evolved. Not only, "[t]he content of veterinarians' knowledge has porous and protean borders" (Berdah 2012), but these porous and protean borders induce an almost permanent renegotiation of knowledge and status. The systematization of knowledge is accompanied by a work of "cutting out borders intended to establish a double institutional but also cognitive demarcation" (Berdah 2012). Between the end of the eighteenth century and a long nineteenth century, French vets were obliged/forced to fight not only against smiths but also they had to define their fields of expertise compare to medicine, agronomy, biology, etc. In doing so they could collaborate with other field of expertise, but they had to preserve themselves, including in terms of social and economic position.

Thus, to organise the book, it seems relevant to the editors to adopt a more methodolical approach. The more useful way seems to us to wonder what is “traditional” in rural history, what is less, and what is not. What is “traditional” is the fact that gradually farmers (and aquafarmers) became like spiders in the net with some practical related understanding of the many disciplines at stake, taking links in between for example veterinary aspects and indoor

[9] Forecasts for the use of antibiotics in livestock farming are mixed, but they are never optimistic (see for example Van Boeckel and al. 2015; Tiseo and al. 2020). In the aquaculture sector accurate data are sometimes missing and render forecasts difficult (Shar and al. 2020).

environment, as well as between feeding and sexual reproduction in dairy farming more or less for granted.

What became more or less "traditional" since 20 years, is that sociologists, economic historians, historians of science, among other, could help rural historians[10]. What is not really common, is the participation of scientists in a rural history collection. The transdisciplinary ambitions with this book will, hopefully, and to some extent, contribute to the merging of perspectives, to reduce some gaps, in the wide field of history of animal farming, it also offers a means to organise the book. The aim is not to separate chapters written by historians (mostly rural/agrarian historians) and chapters written by non-historians. The aims are double: for rural historians the aim is to set questions with the help of expertise foreign to their discipline; for sociologists, economists, microbiologists, veterinarians the aim is to write as historians when they answer to questions asked by rural historians[11].

The first part of the book, taking into account of the progressive penetration of the sociology and history of science in rural history and of the necessity to be helped by economic and cultural history, related the gradual scientification of rearing from the end of nineteenth century on. In the second part, the floor is given to a large set of expertise from history and sociology of science and economy, to microbiology, and veterinary medicine. It shall be centered around two types of question which are at the core of medicalisation of rearing: the role of veterinaries and the spreading of antibiotics uses. It is not to say that the veterinaries was responsible of the expansion of the use of antibiotics, but to underline that the way of development of rearing developments and changes, that are perceptible since the end of the nineteenth century, was nowadays dependent of a multitude of actors and actants (to use a latourian term) whose expertise could not any longer be the exclusive property of rural historians who have to take advantage of that[12].

The first part of the book, devoted to "Animal husbandry and dairy production and consumption", is made up of a total of seven chapters, all of which deal with national case studies: the United Kingdom, Sweden, Italy, France (in comparison with the Italian case), The Netherlands and Spain (two chapters). In turn, the set of works that make up this first section of the book presents diverse chronologies that, nevertheless, would cover a period of around one hundred and fifty years (approximately from 1870 to 2020) in a comprehensive manner.

Certainly, the topics covered here are quite diverse: from the change in the functionality of livestock statistics (sheep herd) in the UK between the 19th and 20th centuries, to the satisfaction of milk protein consumption needs in Spain and the obligation of the dairy industry and supermarkets to diversify their supply of dairy products, to more global and long-term views on the evolution of the dairy sector in Sweden, Friesland (The Netherlands), Galicia (Northwest Spain) or Northern Italy, or issues related to the need to adapt (throughout Europe)

[10] About the importance of history of science and technic see Fitzgerald and al. 2018.

[11] In not any case the aim is to make the history of a field of expertise.

[12] We can evoke several works who are in line with this kind of issues. The introduction of Peter Moser and Tony Varley to the 8 volume of this collection, in which authors bored on the work of the economist Georgescu-Roegen, could be viewed as a sign of this turn in rural history (Moser and Varley. 2013). It is of course possible to quote the works of Tello and al. 2014, Tello and al. 2016 and ali., Gonzales de Molina and al. 2020, which were inspired by a social metabolism problematic. The works of Ernst Langthaler about soybean which interpreted the soybean expansion with the help of the commodities frontiers scheme (Langthaler 2020), or trhough the lens of food regime (Langthaler 2018), or, finally, in another perspective the work of Tiago Saraiva about fascist agricultural politic (Saraiva 2018), etc. Without doubt, the rural history has taken a new pace since 20 years, and changes accelerated since 10 years.

cattle feed to the evolution of the agricultural products market, as shown by the text on the use of oilseed cakes to feed cattle at the end of the 19th century, in the context of the fin-de-siècle agricultural crisis in France and Italy.

In any case, and despite the diversity of themes and approaches in this first part, it is possible to find in the texts a whole series of cross-cutting issues or common denominators to which readers' attention should be drawn.

The works as a whole highlight the existence of a historical process of intensification and "modernisation" (in scientific, technological and industrial terms) of livestock farming in general, and of the dairy sector in particular, throughout Western Europe from the end of the 19th century (approximately from 1870 - 1880) to the final decades of the 20th century (1970 - 1990).

However, it is clear that the decisive decades in this large-scale production specialisation were those immediately after the Second World War[13]. In this long historical process of dairy specialisation, from the point of view of livestock selection, there is also a common tendency towards the adoption of a specific breed, first the Friesian, and later the Friesian-Holstein, as the leading breed in the intensification process, due to its high production capacity in litres per cow per day. It is also important to understand that this process took place at different rates and with different chronologies in the different national cases, distinguishing (sometimes not as clearly as one might think) between early comers (Denmark, The Netherlands, Sweden) and late comers (Italy, Spain or Portugal).

In any case, from the last decades of the 19th century and throughout the first third of the 20th century, livestock improvement (of breed morphology, feeding, animal health and hygiene, milk yields of cows) was already underway throughout Europe. In fact, the final result should not hide the fact that the knowledge and practices of livestock improvement always started from the local sphere. At first, from the breeders themselves, very quickly organised into local and regional associations (cooperatives, unions), which in some places took the step of transforming themselves into powerful cooperative production and industries... As part of the processes of specialisation and technological innovation, this network became increasingly dense and complex, with the growing involvement of local and regional institutions for the promotion of livestock farming, of scientists and technicians, of the agronomic institutions for which they worked and, finally, of the State administration, completing the journey from the local to the State level. However, we must never lose sight of the importance of this first step (local) and of this first stage (before the Second World War), especially from the point of view of the potential of peasant forms of innovation in relation to the present challenges of sustainable livestock farming.

Another fundamental vector of this part of the volume concerns the changes in the diet of the European population, especially after the Second World War, but by no means less so between the end of the 19th century and the 1930s. The growing demand for animal protein, for meat, but above all for milk and its derivatives (butter, cheese) decisively conditioned the very processes of livestock breeding. Not only from the point of view of the selection of breeds

[13] It is nevertheless worth to remain, that as soon as the 1930s effort of modernisation was undertook in different countries including in countries under fascists regime as underlined Tiago Saraiva (Saraiva 2016). But the efforts to “modernise”, in fact to industrialise, agriculture were indeed constant since the middle of the 19th century for the mechanisation of american’s agriculture see Fitzgerald (2003), for the emergence of chemical fertilisation in France see Herment (2021).

or the importation of those with higher productive capacities, but also from the point of view of the improvement in the feeding of livestock (such as various types of cattle).

These key points of the book, which we have just mentioned take on a specific character, almost always in a national perspective and in one case in a comparative way, in the seven chapters of this first part, which we summarise below from the point of view of their contents.

In her contribution (chapter 2) Karen Sayer critically analyses British livestock statistics for a century, between 1866 and 1966, focusing on the data relating to the evolution of the total number of sheep. The appearance of stability in the number of sheep hides very significant qualitative changes, both in terms of production specialisation (from wool to meat) and in the territorial distribution of the flock. For the author, official statistics, initially designed to count the number of live sheep (and the impact of deaths due to disease) must be understood as cultural artefacts and political products of the period in which they were designed. In the British case, statistical data served to construct two antagonistic identities among farmers: the scientific (progressive) farmer who was inclined to join in the scientific and accounting management of his farm in the interests of the national economy; and the traditional, individualistic and routine farmer who refused to submit to the control of official statistics.

In chapter 3, Carin Martiin undertakes an ambitious, long-term investigation (1870 - 1995), identifying, from the analysis of the local level, three models in the evolution of Swedish dairy farming. The first model (between 1870 and the mid-1920s) was characterised by challenges in the form of cattle feed shortages, low milk yields and fear of cow malnutrition; the second (from the mid-1920s to the early 1960s) involved a moderate increase in milk yields despite limitations in cattle feeding. The third model, between 1960 and 1995, was strongly influenced by the demands of Swedish and international economic policy, in particular the indirect incentive for the disappearance of smaller dairy farms and the survival of larger-scale intensive dairy farms. For the three models, the author designs an interesting calculation of the feed required (in terms of energy and protein) to obtain the milk yields of each of the models.

In chapter 4, Luca Andreoni and Laurent Herment, starting from the challenges for European agriculture (the so-called agrarian crisis of the late 19th century) posed by the integration of agricultural markets at the global level, study the shift towards livestock farming and an increasing specialisation in dairy farming. In the context of livestock improvement, the authors examine the central role played by concentrated feeds (oilseed cakes) in livestock feeding in both countries. They pay attention to the role of the agricultural press, farmers' associations, scientists and official institutions in informing farmers about the wide range of oilseed cakes available on the market, their different uses (as fertilisers or cattle feedstuff) and their nutritional qualities and the fight against their adulteration (fraud). At the end of a gradual process it appears that if scientific expertise were unavoidable, the determination of what is fraud and what is not depend crucially of a process of negotiation between industrialists, officials, scientists and farmers' union.

Chapter 5, by Telmo Otero and Daniel Lanero, explores the historical process of dairy specialisation in Galician agriculture (Northwest Spain) from the first decades of the 20th century until the end of the Franco dictatorship. In their text, the authors argue that dairy specialisation intensified from 1960 onwards as part of a state-led process of agrarian modernisation. However, even before the dictatorship (during the 1920s and 1930s) there had been important innovations in the field of livestock improvement, coinciding with changes in diet that led to a greater demand for milk consumption. The Franco regime meant the

imposition of a model of industrialisation of agriculture (including milk production) that broke with the previous dynamics of peasant innovation, with the associative articulation of livestock farmers and with their close relationship with technicians.

Marco Marigliano's text (chapter 6) explains the process by which the Friesian became the predominant dairy cow in northern Italy from 1960 onwards. He does so by looking at two main factors: the role of breeders' associations and technological innovations. In this chapter, the author explains how livestock innovation in Italy moved from the local level, with the leading role played by private individuals and technicians acting relatively freely in each province, the Itinerant Teachers, to the State sphere. An important factor in this change was the growing demand for milk and cheese by the population in the post-war period, which made it necessary to increase productivity, also through better livestock farming. New technological requirements (related to genetics) forced the State to play a more active role, which partly explains the State's promotion of breeders' associations.

The next chapter (chapter 7), by Ronald Platinga, Merijn Knibbe and Marijn Molema, explains the early and successful dairy specialisation of the province of Friesland (The Netherlands) from the end of the 19th century. However, the authors focus especially on the period 1950 - 1990 and the concern shared by all actors (farmers, cooperative industries, institutions and scientists) to improve the protein content (percentage) of milk, which was not fully achieved until the importation of selected Holsteins from North America in the 1980s. Interestingly, the authors show that livestock improvement in Friesland (indeed anywhere) must be understood as a multi-causal process, far beyond the achievement of a specific objective. In the case of Friesland, one should consider the cultural preference of farmers for a traditional type of cow (small and robust), which might not necessarily be the most productive. However, other factors such as an increase in farm size and a more efficient use of water resources also played an important role in the improvement of yields.

The first part of the book ended with a contribution by Fernando Collantes (chapter 8). In his work, the author explains the significant increase in the consumption of milk and dairy products in general in the Western world ("Global North") after the Second World War. He compares this development with that of Spain, which reached the same point somewhat later and through a short and accelerated nutritional transition between 1960 and 1980. The author raises the problem for the dairy industry and the distribution sector (supermarkets) when consumers took their dairy calorie consumption needs for granted in the 1970s - 1980s. The industry was then forced to diversify its offer (dairy desserts, liquid yoghurt, different types of milk, etc.). The author ends his text with a very interesting contribution on the impact that inequality and income differences between sectors of the population have on the type of demand (and access) to dairy products, differentiating between basic and sophisticated.

The second part of this book highlights the roles of several professions involved in livestock farming, especially veterinarians but also agronomists, geneticists, technicians, and other experts. Substantial attention is paid to veterinarization in a body of work that allows us to have a broad national scope and a diverse thematic approach, yet with substantial general relevance. In spite of different ways into these matters, the authors draw similar conclusions in pointing at These relations included, also, the preservation of the veterinarians' professional identity and demarcation to other professions, such as agronomists. Moreover, the veterinarians had relationships to consumers/culture of consumption and animal health, environment, and food safety. Furthermore, the genesis and historical evolution of the legislation of hygienic-sanitary control of milk and livestock products is analysed, as well as its implementation through concrete policy measures in the care of livestock or the conditions of the stables.

Accordingly, the veterinary profession is considered in a wider context than as a matter of mending sick animals. It is also interesting to note that parts of this history was developed in contexts of comparably small scale farming, before much of the scaling-up of animal farming in recent decades. Parts of this history may thus be considered in terms of the hen and the egg, for example to which extent antibiotics paved way for scaling-up, or vice versa.

In the chapter 9 of this book Karl Bruno, focusing on Sweden, writes about the new role of veterinarians in reproduction and artificial insemination, and about reproductive health in dairy cattle along the first part of the 20th century. His paper analyses the development process in Sweden of 'sexual health control' in dairy cattle as a set of veterinary practices for monitoring reproductive health in dairy cows, between c. 1910 and 1960. Bruno discusses how such control became contested and argues that this reflects broader concerns with the distribution of labour and expertise in a changing system of cattle breeding and cattle husbandry. In the case of Sweden, the author argues, artificial insemination was carried by veterinarians, which differed markedly from Denmark, Britain and the United States, where independent non-veterinary technicians played a much bigger role.

In chapter 10, with somewhat earlier references, before the Civil War (1936-39), Diego Conde and Lourenzo Fernandez Prieto, highlight the role of the veterinary profession in the improvement of livestock in XXth Century Spain. The authors analyse the initiatives carried out from the State and the veterinary profession itself, as a part of the corporative struggles with other professions, such as agronomists, and the veterinarians' search for a greater social recognition of the veterinary science and profession in Spain. The Spanish case demonstrates the incorporation of veterinarians into a sphere of public administration, including new corporate and professional roles. According to the authors 'Throughout the period of study, most practitioners were united by an interest in gaining prestige, respect and social dignification for the profession.' At the same time, it is clear that the process of affirmation of Spanish livestock farming as a differentiated productive sector in the context of the great transformations effected by the second wave of industrialisation was linked to the consolidation of the veterinary profession and its statal and professional configuration in Europe and America.

In chapter 11, focusing especially on antibiotic growth promoters, veterinarian Kristina Nordéus pays attention to processes around the ban of these in the European Union in 2006. The author argues that the food crises of the 1990s contributed to a subsequent remodeling of the EU food safety system and that this was a fundamental change that paved way for the phasing out of antibiotic growth promoters. In her chapter, the author considers the role of science in the development of ideas in these matters, and looks at actions taken by different stakeholders, with a particular focus on the Swedish acting as a new member state in 1995. As regards the banning, the scientific community was polarized, and those opposed claimed that the bans for being 'unscientific' which, as argued by the author, illustrates a dilemma in applying the precautionary principle.

Antibiotics plays the main role in the next following chapter, too, written by Annick Jacq, whose chapter 12 deals with the use of antibiotics in French aquaculture, a field that has long been shadowed by earlier concerns about antibiotics in agriculture. The author emphasizes the difficult emergence of this as a public problem, and does, among other things, propose an analysis of the debate concerning the use of antibiotics in French aquaculture as a potential cause for development of antimicrobial resistant bacteria since the 70s, as it has been framed by different actors such as professional and consumer associations, scientists, veterinarians, regulatory agencies, and environmental NGOs. Moreover, Jacq argues that despite some

scientists' questioning of the use of antibiotics in aquaculture, especially after 1990, the French debate was long primarily maintained within the scientific and expert arena.

In the chapter 13, Alexandra Waluszewski contributes with a different perspective on antibiotics, antibiotics in perspective of issues, asking: Who is paying for use of antibiotics in pig meat production as an element of the innovation system? And how was the cost of change distributed, when the main costs appeared in the producing setting and the main benefits in health care systems, in environment and society at large? According to the author it is, in fact, possible to radically decrease input of antibiotics, but raising these kinds of questions about how to distribute the cost and benefits of the required system innovation. With similarities to the previous chapter about antibiotic growth promoters, this chapter deals with the fact that insiders, such as farmers and the Swedish Farmers' Association, took on a role about these issues that are more commonly represented by 'outsiders' such as interest groups, media debaters and activists?" Among other things, Waluszewski argues, with regard to Sweden, that the strong links between the cooperative owner and the owned companies became pivotal; a mobilising and coordination force behind a number of measures contributing to precautionary health and biosecurity.

Finally, in chapter 14, Nicolas Fortané turns the readers' attention to 'The rise and fall of ecopathology' in France. According to critical looks by some veterinarians, the intensification of animal production had deteriorated animal health and many farmers' socio-economic situation, at the same time as other veterinarians were criticised for being alienated to livestock farmers. To this background, ecopathology was developed as an alternative form of veterinary medicine, born in the 1970s and remaining to the 1990s. In his chapter, Fortané finds that ecopathology failed as regards its initial ambitions. One of the reasons for the failure was, according to Fortané, that one actually came to support rather than challenge the criticised industrial forms of livestock farming. Another reason was that the ecopathological knowledge had prevented changes in veterinary medicine.

From the present and from the debates that nourish this book, a cultural and ideological approach has been essential to address the past and present of the sector. To think in terms of the future, approaches from the history of science, culture and identities that go beyond economic, consumption or environmental history are necessary to understand and historically explain livestock farming from the present.

With this books we would like add a milestone in a current of reflection which relates to both the historiography of the rural world and the future of agriculture and livestock farming. Since the 1990s, the historiography of the rural world has experienced a real revival, more or less noticeable depending on the country, relying, as we have already underlined above, on a multitude of expertise.

Agricultural and livestock practices that unfolded since the middle of the 19th century were criticized very early on, especially since the massive use of pesticides and the industrialization of agriculture and livestock. One only has to remember the impact of the works of Rachel Carson and Ruth Harrison. However, the breeding trajectory continues to unfold, almost as if nothing had happened. What can we attribute this to? We can think that this is due, at least in part, to the way in which animals are designed. The idea that the animal is a machine is not new. This idea was quite common in the 19th century, and even much earlier. It applied particularly well to draft and plowing animals. What is undoubtedly new with the industrialization of the breeding of hens, pigs, cattle, etc. and with aquaculture, is the fact that all animals are all more or less designed as machines. But what kind of machine are we

talking about? And how talking about a "machine" can help us better understand the contemporary trajectory of animal husbandry, but also the significance of the resistance which can be identified among a part of breeders, and a large part of consumers.

Beyond the irreducible specificity of each species, and the specific goal of each type of breeding, we will find the same type of questions among breeders from the end of the nineteenth century on: from one hand, how to increase the animal's growth rate; how to get the maximum amounts of products from the animal (fat, meat, protein, milk, eggs, etc.); how to feed it economically, etc.? From the other hand, how to prevent diseases, mortality, counteract aggressiveness or spleen, compensate the lack of sun, the lack of air, etc.? Of course, for each species the answers offer a range of specific ways, but the logics of the answers will often be common to all types of breeding, depending on the period and (the sometimes chaotic) advances in science (antibiotics, use of animal meal, artificial insemination, genetic engineering, etc.). In the end, each species only really seems find its individuality in the highlighting of one of its particular traits (or a set of traits) that, scientists, officials, firms, and breeders and their cooperatives will seek to promote or combat (% of flesh % of fat in pig, % fat or % milk protein, number of eggs per unit time, growth rate, etc.).

The life of the animal appeared sliced in order to maximize its ability to meet the expectations of the breeder at the moment "t". The animal becomes an abstract animal or, in certain cases, perhaps, a succession of abstract animals. It could be considered as an abstract machine in the sense of Gilbert Simondon (or to be more precise "abstract technical object"). In the first chapter of his book, *Du mode d'existence des objets techniques*, Simondon analyses the genesis of the internal combustion engines.[14] He concluded that the first engines were abstract in the sense that in these machine "the different parts of the engine are like individuals who could be thought of as working each in his turn without their ever knowing each other […] the early engine is a logical assembly of elements defined by their total and single function […] In this case, the integration of the particular unit into the ensemble involves a series of problems to be resolved, problems that are called technical but which, in fact, are problems concerning the compatibility of already given ensemble" (Simon 1958 reed. 2012, 24). Conversely, in the modern engines, "each critical piece is so connected with the rest by reciprocal exchange that it cannot be other than it is" (Simondon 1958 reed. 2012, 23). In that sense he qualified the modern engines as "concrete". It could be seemed that we are very far from the agriculture and the rearing practices. But further Simondon indicates that, the abstract technical object, the "primitive" technical object is far from a natural object. because "it is a translation into material of an ensemble of scientific notions and principles that at most basic level is unconnected one with the other and that are connected only by their consequences that converge for the production of a looked-for consequence" (Simondon 1958 reed 2012, 56). Conversely, the "concrete object", the "advanced object", is closed to the "natural object" because it "approximates the mode of existence of natural object. It tends to internal coherence, and towards a closure of the system of causes and effects which operate in circular fashion within its boundaries" (Simondon 1958, reed 2012, 56). After, this passage, Simondon examines briefly the case of a greenhouse plant, with double petals, which cannot reproduce itself, and underlines than in this case: "Making natural object artificial gives results that differ from those effected by technical concretization. […] The initially coherent system of biological functions has been opened up to functions that are independent o each other and that are related to one

[14] It seems more relevant to quote Simondon than to make a paraphrase of his book. The translation was largely inspired by the translation propose by Lilian Mellanphy (1980), available in internet consulted the 22 May 2022. The references are those of the French reedition of 2012. We want to thank Clémentine Lessard to read this part of this introduction, and of course all faults and errors are ours.

another only by the gardener's care". It could then conclude that "artificialization is a process of abstraction in the object which is rendered artificial" (Simondon 1958 reed 2012, 57)[15].

If we adopt this analysis grid, we can draw two conclusions which allow us to better understand the trajectory of breeding practices and the emphasis placed on the need to adopt a holistic approach to breeding in several texts of the second part of the book[16]. Firstly, this would be the only way for the industrial animal, from an abstract machine, to become a natural object again. Secondly, the abstract animal cannot be any more a natural object, but only an abstract object, and the more it is artificial the more it is abstract. In consequence, either at an individual level or a collective level, artificial animal did not have any more the power to self-regulate, and men have to intervene at any moment of the process of breeding to repair, including in providing to it increasing amounts of complemented feedstuff, antibiotics, vitamins, light, air, etc. This is why the holistic approach, which wants to give more space, more liberty, more autonomy to the animal, respects the basic needs of animal, and does not assess its performances with a unique indicator is promoted as the only way that would make it possible, to envisage, for example, the abandonment of antibiotics. It could be a way to reverse the process that transform the animal in an abstract object.

The idea that the industrial agriculture bears on a process of constant need to repair damages it causes, has been developed recently by Romero (2021) in a book about the uses of pesticides in US agriculture before the WWII. It seems that such a need could be interpreted as a way to counteract permanently the artificialization, the "concretization" of the natural object (in a Simondon sense). In breeding, the artificialization of animal, their gradual transformation in abstract object, reach dizzying heights, and so the needs to repair becomes continuous.

If the work of Simondon can help us to better understand the trajectory of breeding is does not tell us the whole story for several reasons. Firstly, as remains us Fernando Collantes, in the chapter 8 of this book, behind the picturing of farm animals as machines, the implementation of an industrial logic, conforms to the 'Fordist' model, appear as a mean to lower the price of protein.

Moreover, perspectives have changed with regard to circumstances such as hunger and/or other threats, or the polar opposite in terms of problems with overproduction and problematic surpluses. But the link between animal care, sustainable breeding practices and the level of production is far from to be clear. In case of food scarcity, the attention to animal welfare and/or methods of production may be subordinated to the growth of volumes devoted to supply meats, eggs and milk. But, conversely, in case of overproduction, or in case of industrial production, the animal welfare seems often ignored, and farmers and meat-packers do not seem paid attention to environmental disasters caused by rearing, not to mention animal welfare.

The issue of medicalisation is also complex. Medicalisation, and especially the use of antibiotics, could be perceived as a mean to replace labour. But medicalization may also have been seen as polar opposite to the old times, with bad hygiene etc.

Finally, besides the industrial rearing and aquaculture practices that are dominant, not only in Europe, but also in USA, Brazil, China, South Africa, etc. there exist also rearing

[15] About the relation between Latour and Simondon see Latour 2010.
[16] See for example the chapter of Kristina Nordeus, and, from a methodological point of view the chapter of Nicolas Fortané.

practices that do not transform, or at least try to not transform animal in abstract object. The scale and the methods of production that are applied today, may not be ideal in all farmers' eyes. Numerous breeders try to find a compromise between external pressure (either techno-scientific or economic) and what is possible to preserve of animal well-being in the farm and sustainability of farming. These aspects differ largely over time, and regionally, which is made clear by the contributors to this book. As example, what was at one point of time considered as large-scale dairy farming in Galicia, may have been comparably small-scale compared to the British countryside. Indeed, animal farming, and production of food of animal origin, is no easy way to cope. Economic context is often, although not always, problematic, and the work hours long. Still, many farmers keep on, unwilling to give up, which speaks for an interest in the animals, and to work with them, as prove the implication of Swedish breeders in the fight against antibiotics. In this sense, sustainable agriculture and husbandry which pays attention to the animal well-being could be think as a culture, or a way of life, and in certain extent a way to resist to the agro-industry. It could be also a way to improve the profitability of the farm. The case of cheese AOP of the East of France specialised in cheese production (Comté, Morbier, Mont d'or, Bleu de Gex)[17] can be evoked to illustrate this point. Dairy farmers decided to refuse the use of automated milking machines to reassure the necessity of a grazing, to preserve the link between farmers and their animals, but also to preserve the brand image of cheese. But it is striking that to preserve the "traditional" way to milk and breed the cows, they were obliged to argue that automated milking machines could not preserve the intrinsic characteristics of milk, because it diminish the solidity of fat globule of milk, and provokes an alteration of milk and cheeses[18]. Then, far from distant themselves of a scientific approach of rearing, they are very comfortable with such an approach that leads in many instances to the industrialisation of breeding and the artificialisation of animal.

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[17] The AOP Comté is the most important cheese AOP in France, this far from to be anecdotal.

[18] Salvi 2022. It is also striking that in this region the specialisation in cheese production caused, since the nineteenth century, the decline, if not the disappearance, of cereals, and, in certain cases, the replacement of natural meadows by the monoculture of leguminous. In the same time breeder associations do not allow to exceed a given quantity of milk by hectare. Thus the relations between dairy farmers and modernisation are very complex, and need a careful attention to avoid doing sweeping judgment.

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