SARTONIANA

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Sarton Chair of the History of Science
Ghent University, Belgium

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Introduction

In volume 36 of Sartoniana the Sarton lectures of the academic year 2022-23 are included. Respecting the tradition of Sarton it contains lectures devoted to the history and philosophy of the various sciences.

The concept of a new history of science as developed by Van Paemel is a very good reminder of the original idea of Sarton. He already rejected a pure western enlighment model and always favoured a large consensus and broad scope englobing as well different scientifical disciplines as various civilisations.

The marvellous lecture of Fresco with its parable of the fox and the hedgehog should be obligatory for politicians. The documented analysis about the history of food science based upon an old story from Aristoteles is a program and envoy for university lectures in every field of research.

The paper of De Langhe describes the long history of Vitamin C as a necessary nutrient . Recent work has demonstrated the major importance here of the structure and level of the haptoglobulin.

The monograph by Van Hove not only gives an outline of the genesis and nowadays field of the disability studies but wants to involve the reader in a new beautiful dream about listening to the “hundred voices” to be able to see the least perceptible of things.

Claus in a very nice paper develops the separation between creationists and evolutionists not based upon religious or philosophical differences but between variable belief in perfection.

The documented monograph by Dunand about labour relations , its societal and legal rules and impact, provides a fascinating overview of the profound changes in personal relations occurred during history between employer and employee.

The nice essay by Wittrock depicts the historical evolution of sociology, originated in Europe during the late eighteenth century, from Max Weber to the present time.

Unfortunately the paper by Wanner, given already the previous year arrived to late for printing in 2022 and was therefore included in this volume. It develops a mathematically detailed outline based upon the ideas of Von Euler and Fourier to solve a problem recently developed by Budd and Stockie.

July 2023.

Laudatio Geert Vanpaemel

Maarten Van Dyck, Steven Vanden Broecke

It is a great pleasure to deliver this eulogy, which I pronounce also on behalf of my colleague Steven Vanden Broecke. Steven is today in Samarkand in Uzbekistan, and so perhaps embodies the theme of the lecture that will follow shortly. After all, this city on the Silk Road, at the crossroads between East and West, was the site of one of the most important astronomical observatories of what we somewhat parochially call the Middle Ages and Early Modern period. In the second number of the second volume of Isis, which only appeared in 1919 after a four-year hiatus, George Sarton already discussed an edition of the observations made there under the direction of sultan Ulugh Beg. That same volume of Isis was opened by a reflection on the importance of history of science in the context of the war that had just ended. In this short text, titled "War and Civilization," Sarton emphasized his favorite theme, which he called the "new humanism." That new humanism was to take human civilization in a new direction by convincing scientists that their knowledge was not simply a specialty but was first and foremost an expression of fundamental human values and an engine of cultural progress. The way to awaken that deeper self-awareness was through the methods of the classical humanist, the study of text and history, but now deployed to fathom the evolution of the sciences. That lofty ideal, according to Sarton, called for a professionalization of the history of science: there was a need for a community of researchers who could specialize in this discipline. Only through the detour of discipline formation could history of science fulfill the mission of the new humanism.

No doubt Sarton's humanism is no longer ours, but the hope that the history of science can be a privileged place to nurture reflection on science remains

an important raison d'être for the discipline even today. We also see this reflected in the inspiring work of Geert Vanpaemel. In that work we can distinguish a number of dimensions, each of which should be emphasized.

First, there is of course his particularly rich list of academic publications. His research ranges from the sixteenth century to the twentieth century and covers an exceptionally wide range of fields of scholarship. It covers both the place of the Southern Netherlands in the reception of Cartesian natural philosophy in the seventeenth century and the introduction of what some of us still know as "modern mathematics" in elementary school education in the second half of the twentieth century, to refer only to his 1985 doctoral dissertation and a recent book published in 2019. In doing so, his work is always characterized by a careful reflection on the methodological requirements that are crucial for serious work in the history of science.

At the same time, Geert has always been much more than a purely academic researcher, which brings us to the second dimension of his work. Over the years, he has continually sought to give history of science a visible place in how we culturally interact with our past. He organized exhibitions, edited public books and took an important role in rethinking how we in Flanders deal with our academic heritage. Like few others, Geert ensured that there are tools today that allow us to integrate the history of the sciences into how we look at our national history. For example, he was one of the driving forces behind the standard two-volume work on History of the Sciences in Belgium and was the initiator and inspirer of BESTOR -the Belgian Science and Technology Online Resources-, an unsurpassed online treasure trove for the history of science and technology in Belgium. However, let there be no misunderstanding here: that focus on national history has always been intended to place it in a global historical context in novel ways. This evening's lecture will no doubt further illustrate this.

Finally, there is the institutional side of Geert's work. By the time he defended his doctorate in 1985, more than seventy years had passed since George Sarton had left Belgium. And while Sarton had been relatively successful in the United States in his efforts to engage in discipline-building for the history of science, things remained mostly quiet in Belgium on that front. Education in the history of science was almost non-existent, research positions almost unthinkable. Geert Vanpaemel played an important role in ensuring that Sarton's call for professionalization was heard after a long delay and that the situation looks different today. His own professional

trajectory following his doctorate bears witness to how difficult it was to give research and teaching in the history of science a serious place within higher education in Flanders. This did not prevent him from taking on numerous roles, for example as editor of the journal Scientiarum Historia, or as an active board member of organizations such as Zuid-Gewina and the National Committee for Logic, History and Philosophy of Science. That his very recent retirement allowed him to take leave of a full-time position as professor of History of Science and Science Communication at KU Leuven shows how he was able to put the importance of a professionally practiced history of science on the institutional agenda. Even today, history of science continues to occupy a somewhat precarious place at the university, but thanks to the work of Geert Vanpaemel, the difference with the situation in 1985 is nevertheless particularly significant.

We would therefore like to end by explicitly thanking Geert for all his work, and we are particularly looking forward to his lecture.

East and West. From George Sarton to the Global Turn in the History of Science.

Geert Vanpaemel

It is a great honor for me to be nominated as the recipient of the Sarton Chair 2022 at Ghent University. I am particularly grateful to the Faculty of Arts and Philosophy for proposing my candidacy for this chair. I hope that my inaugural lecture, which touches on topics which were very dear to George Sarton, may contribute to a reappraisal of Sarton's legacy and to stimulate new developments in the historiography of science.

East and West is the title of a lecture, delivered by George Sarton (1884-1956) in 1930 as one of the Colver Lectures in Brown University, and published the next year as a chapter in what became one of his most often cited books, *The History of Science and the New Humanism*. It is a most eloquent and forceful expression of Sarton's views of the history of science and its place in civilization. To Sarton, science was a global phenomenon, a measure of the growing intellectual and cultural evolution of mankind. In his lecture Sarton set out to show "the immense contributions which Eastern people made to our civilization." Sarton was a specialist on medieval Arabic science. His lecture may have seemed, therefore, a rather straightforward exposition of his own research, but in fact, Sarton had a loftier message in mind. Sarton felt that the contributions of the East were not only located in the past and that they were more intimately connected to our own scientific advances than we might imagine. East and West had both contributed to our modern science, and would undoubtedly continue to do so in the future. "We are used to think of our civilization as western," he explained, "we continually oppose our western ways to the eastern ways, and we sometimes have the impression that the opposition is irreducible. […] Now that impression is false, and as it is likely to do considerable mischief in both East and West,

it is worth while to disclose the error as fully as possible. […] It is wiser to consider them as two visages, or let us say, as two moods of the same man."[1]

In my lecture I want to expand on the vision of Sarton. Science is indeed a global phenomenon, and has become even more so during the last century. But it also has become a contested field entangled with issues of expertise, power and domination. Science has been (and in many ways still is) an instrument of colonization, yet, at the same time, it is an important and much coveted asset for any civilization on the planet. The role of science and technology in the creation and maintenance of the current world order cannot be denied. Historians of science cannot and do not remain oblivious to the wider impact of science on political, economic and social relations. Since its formal creation as a discipline, the history of science has always responded to the current debates surrounding science and its role in society. In this lecture, I will explore some of the recent venues through which historians of science are approaching the role of science in world affairs.

One important issue in dealing with the (neo-)colonial aspects of science is its denomination as being Western. In many historical accounts of science, the birth of modern science, often termed the Scientific Revolution, is dated roughly between 1500 and 1750 and located geographically in Western Europe. As modern science became an important tool for Western countries in the colonization era, it also came to be recognized as being Western in its very essence.[2] Western science incorporated Western values, without which a scientific state of mind could not be reached. Being modern, i.e. rational and scientific, could only mean being Western. These assumptions have recently been questioned. The Eurocentric ideology inherent in the older history of science has come under attack and new answers are emerging to restore a more balanced and global view of science.

My lecture will be divided in three parts. In the first part, I will briefly explore the Eurocentric bias in our the history of science and how it has escaped notice for so long. In the second part I will focus on the need for a comparative and global approach to the history of science. Finally, I

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1 G. Sarton, *The History of Science and the New Humanism* (New York, 1931), p. 80-81. On Sarton, see C. Doris Hellman, "George Sarton, Historian of Science and New Humanist," *Science,* new series, 128 (1958) 641-644; Arnold Thackray and Robert K. Merton, "On Discipline Building: The Paradoxes of George Sarton," *Isis* 63 (1972) 472-495; Lewis Pyenson and Christophe Verbruggen, "Elements of the Modernist Creed in Henri Pirenne and George Sarton," *History of Science* 49 (2011), 377-394.

2 Marwa Elshakry, "When Science Became Western. Historiographical Reflections," *Isis* 101 (2010), 98-109.

will reflect on how the history of science needs to "provincialize Western science"[3] in order to reconstruct a new grand narrative that can properly integrate a world history of scientific cultures around the globe.

The birth of modern science

It took me many years before I even started to realize how much the history of science was structured around a very limited and exclusive narrative, favoring a Western, Eurocentric perspective. I was aware that during the Middle Ages mathematicians and astronomers from Islamic countries had contributed substantially to the body of knowledge that was available to European scientists at the beginning of the Renaissance, but I had no doubt that the 'true' birth of modern science could only be found in the European Scientific Revolution of the seventeenth century. It was not that I did not care about non-Western histories, but most historical accounts that I read at the time accepted without further reflection the dominant position of Western science and technology of which the Westernization of the world was a logical consequence.

This position is exemplified by the English historian Geoffrey Barraclough, who in a television series broadcast in Japan in 1974, singled out the Scientific Revolution as the driving force behind the European-led globalization of the world. Barraclough believed that science had become "part of the equipment of all the world's peoples." The European origins of science did not prevent science from becoming universal. Yet, it was from Europe and through Europe that science revolutionized the world. "One can legitimately say that the Scientific Revolution ushered in a new phase in man's history, a phase without precedent, and which for the first time in history has made the whole world one."[4] Barraclough's observation was only a representation of what many historians of science professed and believed. The triumph of European science, as it was described by many authors, did not, however, obfuscate the negative consequences of the introduction of Western science in non-Western countries, nor belittle the colonial context in which these processes took place.[5] But as far as the development of science was

[3] An expression borrowed from Dipesh Chakrabarty, *Provincializing Europe. Postcolonial Thought and Historical Difference* (Princeton University Press, 2007).

[4] Geoffrey Barraclough, *Turning Points in World History* (London: Thames & Hudson, 1979), p. 27 and 37.

[5] Alfred W. Crosby, *Ecological Imperialism. The Biological Expansion of Europe 900-1900* (Cambridge: Cambridge University Press, 1986).

concerned, the attention of historians seemed to be effectively confined to what happened in a few West-European countries.[6]

There were not many textbooks around that offered a global history of science. In most cases, attention to non-Western science is simply absent.[7] The *Companion to the History of Modern Science* contained a chapter on 'Science and Imperialism', but its main focus was the agency of the Western powers in non-Western countries.[8] The *Macmillan Dictionary of the History of Science* offered entries on Chinese science, Islamic science and Hindu science, but written only in comparison to the Western approach and without consideration of their scientific status.[9] An innovative textbook addressing explicitly the global aspects of science, did indeed have a fair share of non-Western history, but this disappeared completely once the narrative reached the seventeenth century.[10] Jon Agar's book on twentieth century science devotes a few pages to the emerging scientific powers in China and India, mainly to assess the possible threat they may pose to American hegemony.[11] Most recently, James Poskett has written a much acclaimed global history of science, "exploding the myth that science began in Europe." However, he only considers non-Western science in as much as it contributes to or participates in Western science. Poskett makes no attempt to understand indigenous knowledge or to envisage non-Western trajectories in the development of science. There is no re-assessment of European and American science, which actually are absent from his 'global' narrative. Poskett merely fills in some blank spaces in the main narrative without changing the overall picture. [12]

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6 International comparative studies often concerned only a few Western countries. See e.g. Roy Porter and Mikulás Teich (eds.), *The Scientific Revolution in National Context* (Cambridge: Cambridge University Press, 1992); Thomas F. Glick (ed.), *The Comparative Reception of Darwinism* (Chicago and London: The University of Chicago Presse, 1974) has a chapter on Mexico and the Islamic world; Thomas F. Glick, *The Comparative Reception of Relativity* (Dordrecht: D. Reidel Publishing Company, 1987) has a chapter on Japan.

7 For some fairly recent examples, see Peter J. Bowler and Iwan Rhys Morus, *Making Modern Science. A Historical Survey* (Chicago: The University of Chicago Press, 2005); David Knight, *The Making of Modern Science. Science, Technology, Medicine and Modernity 1789-1914* (Cambridge: Polity Press, 2009).

8 Lewis Pyenson, "Science and Imperialism," in R.C. Olby, G.N. Cantor and M.J.S Hodge (eds.) *Companion to the History of Modern Science* (London and New York: Routledge, 1990) 920-933.

9 W.F. Bynum, E.J. Browne and Roy Porter (eds.), *Macmillan Dictionary of The History of Science* (London and Basingstoke: The MacMillan Press, 1983).

10 James E. McClellan III and Harold Dorn (eds.), *Science and Technology in World History. An Introduction* (Baltimore and London: The Johns Hopkins University Press, 1999). See also Philip F. Rehbock, "Globalizing the History of Science," *Journal of World History* 12 (2001) 183-192.

11 Jon Agar, *Science in the Twentieth Century and Beyond* (Cambridge: Polity Press, 2012) 511-516.

12 James Poskett, *Horizons. A Global History of Science* (Penguin Books, 2022). Quotation from the commercial announcement.

These examples can be easily multiplied. Global aspects were (and to a large extent still are) not on the agenda of most historians of science and are not regularly represented in educational texts.[13] In our times, this hardly criticized longevity of the Eurocentric perspective in the history of science has become something of an anomaly in the general field of science studies. From the 1970s on, development economists have studied the transfer of technology from the West to third world countries. They showed that Western advanced technology was not always the most appropriate construct to solve the problems of communities faced with different specific needs and limited resources.[14] This led to a wider reconsideration of the Westernization of the world economy, and the changes it had forced upon local communities.[15] Also anthropologists were steering away from their former Eurocentric gaze. This translated into new approaches to the history of European expansionism. Authors like Eric Wolf and Johannes Fabian revisited the encounters of Europeans with people from other continents from the perspective of the native societies of Africa, Asia and the Americas.[16] Others investigated the inherent prejudices among European intellectuals in describing and evaluating foreign cultures.[17] In Science and Technology Studies (STS) the diversity of national science systems and their relationship to political regimes has been a topic of research.[18] In Science Communication studies, the monitoring of public attitudes to science and technology and the adaptation of communication strategies to local audiences has broadened the scope of practitioners to a wide range of communities around the globe.[19]

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13 To my knowledge, the one exception to this general pattern in textbooks is Dominique Pestre (ed.), *Histoire des sciences et des savoirs*. 3 volumes (Paris: Seuil, 2015), which incorporates extensive chapters on non-Western scientific cultures and global interactions.

14 Frances Stewart, *Technology and Underdevelopment* (London: Macmillan, 1977); Robin Clarke, *Science and Technology in World Development* (Oxford: Oxford University Press, 1985); Ozay Mehmet, *Westernizing the Third World. The Eurocentricity of Economic Development Theories* (London and New York: Routledge, 1995).

15 Serge Latouche, *The Westernization of the World. The Significance, Scope and Limits of the Drive towards Global Uniformity* (Cambridge: Polity Press, 1996).

16 Eric Wolf, *Europe and the People without History* (Berkeley: University of California Press, 1982); Johannes Fabian, *Out of our Minds. Reason and Madness in the Exploration of Central Africa* (Berkeley: University of California Press, 2000).

17 Gustav Jahoda, *Images of Savages. Ancient Roots of Modern Prejudice in Western Culture* (London and New York: Routledge, 1999).

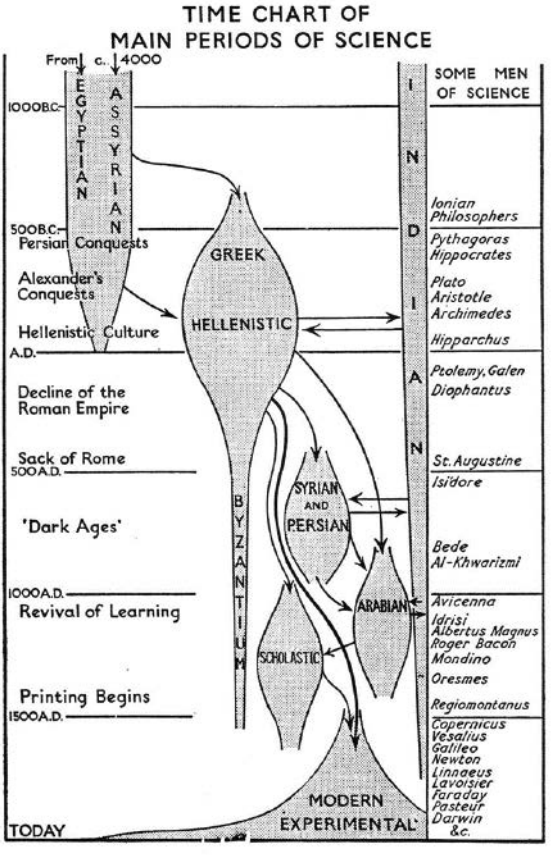
18 Thomas Schott, "World Science: Globalization of Institutions and Participation", *Science Technology Human Values* 18 (1993) 196-208; David J. Hess, *Science and Technology in a Multicultural World. The Cultural Politics of Facts and Artefacts* (New York: Columbia University Press, 1995).

19 Martin W. Bauer, Rajesh Shukla and Nick Allum (eds.) *The Culture of Science. How the Public Relates to Science across the Globe* (London and New York: Routledge, 2015).

The global perspective as developed by other disciplines is not completely absent from the history of science, but is has not become part of the central tenets of the discipline. In the next section I will present five arguments which need to be considered to problematize the position of Western science in the broader, global perspective.

Five arguments

To many people modern science has universal qualities which put it above or outside of any regional boundary. In this view, Western science as it developed over the centuries in Europe and the US cannot be reduced to a particular version of science which is only relevant in the context of a Western socio-economic order. It is futile, according to this view, to look for contingent or ideological content in the body of scientific knowledge, even if such biases may be present at the time of creation of new knowledge. In the end, science is unique and universal.[20]



I believe such a view is not very productive in scholarly

[20] See e.g. Alexandre Borovik, " 'Decolonization' of the Curricula," *The Mathematical Intelligencer* (2023) 1-6. https://doi.org/10.1007/s00283-023-10269-3.

enquiries. As an example, I present the very instructive 'Chart of Main Periods of Science' which was published by F. Sherwood Taylor in his 1949 classic *A Short History of Science and Scientific Thought.*[21] The graph charts the emergence and decline of the main scientific cultures around the globe: Egyptian/Assyrian, Greek/Hellenistic, Indian, Syrian/Persian, Byzantium, etc. All periods are represented by a battleship curve, which suggests a general pattern of how science may be linked to the rise and fall of civilizations, but also how knowledge is transmitted between cultures and how not one culture is dominant in the global perspective. However, from about 1500 A.D. a new scientific culture emerges, which is called 'modern/experimental'. This culture is associated with the names of Copernicus, Vesalius, Galileo, Newton, Linnaeus and others. Its visual shape is very different from the preceding cultures. In a very short period of time (about 500 years) it has grown exponentially until it encompasses the whole world. It pushes all other scientific cultures out of the picture and makes them obsolete.

The problem with this picture is not so much that is misleading or wrong, but that it misses out on so many opportunities to learn more about modern science. By defining modern science as 'experimental', the graph suggests that former scientific traditions were not experimental, and that the use of experiments was something completely new, only to be found in Europe from about 1500. Why not indicate the new culture which came to the fore in Renaissance Europe with a geographical or cultural reference term, e.g. 'European science," of "Enlightenment science"? It would at least bring out the historically contingent nature of modern science in its early phases, connected to a well-defined political or cultural environment. The visual representation of European science would probable again conform to the battleship form, if we take into account the relative marginalization of European science in the wake of the ascendancy of American science after World War I or (modern) Chinese science in the current century. The more differentiated our conception of modern science, the more we can learn about the processes of transmission and circulation and about the embeddedness of knowledge systems in cultural frames.

Still, one could object that the cumulative character of 'modern science' is essentially so different from any of the preceding scientific cultures, that

[21] F. Sherwood Taylor, *A Short History of Science and Scientific Thought* (New York: W.W. Norton & Company, 1949).

a differentiation between different geographical strands of scientific practices is unnecessary and even obscuring its internal coherence. This would legitimate a radical break between modern and earlier versions of scientific pursuits. The only task for the historian of science would then be to document the epistemological revolution that occurred and to indicate the essential characteristics that set apart our modern science. But we know that history did not evolve in that way, that scientific knowledge can occur in many guises, that boundaries between epistemic regimes are fluid and that any 'hard' demarcations are bound to fail. As science is spreading globally and invading an increasing number of social domains, it is all the more necessary that we understand its nature and its power. This cannot be done by treating modern science as a monolith or a 'black box'. The more we are able to observe and analyze science in different contexts, the more we will be able to monitor and to steer science, and to realize its full potential.

The point is not to deny, of course, that there is a continuity between the transformation of science in Renaissance Europe and modern techno-science. But it would be a harmful simplification to consider modern science merely as the logical outgrowth of Newton's experimental philosophy. Science itself has undergone drastic changes in the last few centuries, and is still developing in new directions.[22] The boundaries of our knowledge our constantly shifting, as is our understanding of the world we live in. The European Scientific Revolution is neither necessary nor sufficient to explain the broad development of science in later centuries, or in non-European contexts. The history of this broader movement cannot be fully described by paying attention to Europe (and the U.S.) alone. It is imperative to analyze science within the cultural context in which it functions.

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[22] One can think of a shift towards applied science, the advancement of science by non-democratic regimes, ethical problems raised by scientific findings, the spread of scientific ways of thinking to other fields of knowledge, or the diminishing authority of science and scientists among various layers of society. By way of example, see Benoît Godin, *Models of Innovation. The History of an Idea* (Massachusetts Institute of Technology, 2017); Donald E. Stokes, *Pasteur's Quadrant. Basic Science and Technological Innovation* (Brookings Institution Press, 1997); Simon Ings, *Stalin and the Scientists. A History of Triumph and Tragedy 1905-1953* (London: Faber and Faber, 2016); Laurence Schneider, *Biology and Revolution in Twentieth-Century China* (Rowman & Littlefield Publishers, 203); Audra J. Wolfe, *Competing with the Soviets. Science, Technology, and the State in Cold War America* (Baltimore: The Johns Hopkins University Press, 2013); Richard Weikart, *From Darwin to Hitler. Evolutionary Ethics, Eugenics, and Racism in* Germany (New York: Palgrave Macmillan, 2004); Richard G. Olson, *Science and Scientism in Nineteenth-Century Europe* (Urbana: The University of Illinois Press, 2008); Tom Nichols, *The Death of Expertise. The Campaign against Established Knowledge and Why it Matters* (Oxford University Press, 2017): Alex B. Berezow & Hank Campbell, *Science left Behind. Feel-good Fallacies and the Rise of the Anti-Scientific Left* (New York: Public Affairs, 2012).

A distinction between European, American, Chinese, or African science is a first crucial first step towards a fuller appreciation of the mechanisms behind our current science system.

Second, as the science which developed out of the natural philosophy of the European Renaissance has spread more globally, it is necessary to be aware that this process occurred totally independent from the European Scientific Revolution, or to put it differently, that every culture had its own scientific revolution squarely rooted in the local tradition of knowledge. The emergence of American science at the beginning of the nineteenth century may have more in common with the intellectual movement in Japan half a century later than with the earlier debates in Western Europe. The late nineteenth-century response to Western science in India, in some ways reminiscent of the eighteenth-century response in Tsarist Russia, was imbued with a very specific debate on the place of Hindu culture vis-à-vis British domination. The Chinese reactions to Western science coincided with the final years of the Chinese empire and the forging of a new identity of the nation, as was *mutatis mutandis* the case in the nineteenth century emancipation of Latin American nations against a still dominant Spanish colonial ideology or in the slow embracing of 'new science' among elites in the declining Ottoman Empire.[23] Every one of these stories (including the European) show a different aspect of the interaction of science with incumbent intellectual epistemologies and social power structures. The story cannot be reduced to a simple process of reception, but includes adaptation, resistance and appropriation.[24] A fuller understanding of these widely divergent processes is crucial in coping with the current challenges of global science.

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[23] Nathan Reingold (ed.), *Science in America since 1820* (New York: Science History Publications, 1976); Hiromi Mizuno, *Science for the Empire. Scientific Nationalism in Modern Japan* (Stanford: Stanford University Press, 2009); Gyan Prakash, *Another Reason. Science and the Imagination of Modern India* ((Princeton: Princeton University Press, 1999); Jing Tsu & Benjamin A. Elman (eds.), *Science and Technology in Modern China, 1880s-1940s* (Leiden: Brill, 2014).

[24] For theoretical discussions of this process, see Kostas Gavroglu, Manolis Patiniotis, Faidra Papanelopoulou, Ana Simões, Ana Carneiro, Maria Paula Diogo, José Ramón Bertomeu Sánchez, Antonio García Belmar, Agustí Nieto-Galan, "Science and Technology in the European Periphery: Some Historiographical Reflections," *History of Science* 46 (2008) 153-175; Maria Portuondo, "Constructing a Narrative: The History of Science and Technology in Latin America," *History Compass* 7:2 (2009) 500-522; Fa-ti Fan, "The Global Turn in the History of Science," *East Asian Science, Technology and Society: An International Journal* 6 (2012) 249-258; Thomas Glick, "Science and Independence in Latin America." *Hispanic American Historical Review* 71 (1991): 307-334; Marcos Cueto and Jorge Cañizares-Esguerra, "Latin American Science: The Long View," *NACLA Report on the Americas* 35:5 (April 2002) 18-23: Juan José Saldaña, "The Latin American Scientific Theater," in: J.J. Saldaña (ed.) *Science in Latin America. A History* (Austin: University of Texas Press, 2006) 1-27; M. Alper Yalçinkaya, *Learned Patriots. Debating Science, State, and Society in the Nineteenth-Century Ottoman Empire* (Chicago: The University of Chicago Press, 2015).

A third argument lies in the realization that science has never been a neutral agent in the formation of a global world. From the late eighteenth century on, Western views of other civilizations were informed by a heightened self-awareness of European science and technology as being more advanced than others.[25] The increased mastery of nature that seemed to be in reach of European scientists, set them apart from intellectuals, administrators or artisans in the countries that became subject to colonization. Western experts were ushered in by colonial or foreign governments to improve military and civil technology, health care or agricultural production, in the process creating major social upheaval and causing destruction of existing intellectual networks. Whether this happened in the context of imposed colonialism or in a more peaceful agreement on collaboration or modernization, the effect was in many cases problematic or even disastrous. As James Scott observed, "high-modernist designs for life and production tend to diminish the skills, agility, initiative, and morale of their intended beneficiaries." [26] At the same time, however, the experience of Western experts in colonial territories had a strong influence on the creation and formation of scientific disciplines in the West, ranging from the early needs of the Spanish colonial administration to create effective networks of information and control to the 'living laboratory' of the African continent.[27] Interactions between Western and non-Western scientific cultures need to be analyzed in two directions and with due attention to the political ideologies involved.

As a fourth argument, it is worthwhile to point out that, although science is a fairly global phenomenon, the institutional landscape of science can vary substantially from one country to the other. Science is indeed more than a body of formal, systematized knowledge. It is based on a large infrastructure comprising education, manpower, financial investment, social institu-

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25 Michael Adas, *Machines as the Measure of Men. Science, Technology, and Ideologies of Western Dominance* (Cornell University, 1989).

26 James C. Scott, *Seeing Like a State. How Certain Schemes to Improve the Human Condition have Failed* (New Haven: Yale University Press, 1998) (quotation on p. 348); Joseph M. Hodge, *Triumph of the Expert. Agrarian Doctrines of Development and the Legacies of British Colonialism* (2007); Timothy Mitchell, *Rule of Experts. Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002). See also Jack Goody, *The Domestication of the Savage Mind* (Cambridge: Cambridge University Press, 1977).

27 Antonio Barrera-Osorio, *Experiencing Nature. The Spanish American Empire and the Early Scientific Revolution* (Austin: University of Texas Press, 2006); Jorge Cañizares-Esguerra, *Nature, Empire, and Nation. Explorations of the History of Science in the Iberian World* (Stanford, Stanford University Press, 2006); Helen Tilley, *Africa as a Living Laboratory. Empire, Development and the Problem of Scientific Knowledge 1870-1950* (Chicago, The University of Chicago Press, 2011).

tions, political support and popular understanding (needed for the support of science by non-scientists). Science needs to be firmly embedded in the community and to be part of the public discourse in order to be effective. The religious panic that broke out after the Lisbon earthquake of 1755 shows a rather bleak picture of the impact of modern science on contemporary intellectual life during the European Enlightenment. Similarly the short lived popularity of Newtonianism in the *salons* of eighteenth century France was followed by a radical rejection of the scientific establishment before and during the French revolution (only to be restored in a very different form by Napoleon).[28] The fortunes of science and scientists are constantly in the balance and can be threatened either by popular protest or by state decree. As science has become more global, it has also become more vulnerable to political pressure, cultural diversity and economic competition. The robustness of modern science depends on a global effort to build a strong science infrastructure. Analysis of institutional, social and popular configurations of scientific cultures in the different regions of the world will broaden our knowledge base to manage the challenges ahead.[29]

Finally, science will only be able to play a significant role in modern society if it find a home in the mind and the heart of citizens all over the world. In many ways, the spread of science has been linked, either by force or ideology, to a set of Western values, which were considered to be essential prerequisites to the emergence of the 'scientific spirit' (whatever that may be). This has obliterated awareness of local ingenuity and capacity for innovation.[30] In general, we are badly informed about the history of science

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28 Jean-Luc Chappey, "Enjeux sociaux et politiques de la 'vulgarisation scientifique' en Révolution (1780-1810)," *Annales historiques de la Révolution française* (2004), No. 338, 11-51.

29 Examples of infrastructural studies around the globe James R. Bartholomew, *The Formation of Science in Japan* (New Haven: Yale University Press, 1989); Pascal Crozet, *Les sciences modernes en Égypte. Transfert et appropriation 1805-1902* (Paris: Geuthner, 2008). For popular culture, see e.g. Susan Sheets-Pyenson, *The Cathedrals of Science. The Development of Colonial Natural History Museums during the Late Nineteenth Century* (Kingston: McGill-Queen's University Press, 1988); Joel J. Orosz, *Curators and Culture. The Museum Movement in America, 1740-1870* (Tuscaloosa: The University of Alabama Press 1990); Ian Jared Miller, *The Nature of the Beasts. Empire and Exhibition at the Toky Imperial Zoo* (Berkeley: The University of California Press, 2013). For popularization and science-based propaganda, James T. Andrews, *Science for the Masses. The Bolshevik State, Public Science, and the Popular Imagination in Soviet Russia, 1917-1934* (Texas A&M University Press, 2003); Sigrid Schmalzer, *The People's Peking Man. Popular Science and Human Identity in Twentieth Century China* (Chicago: The University of Chicago Press, 2008); Narender K. Sehgal, Satpal Sangwan & Subodh Mahanti (eds.), *Uncharted Terrains. Essays on Science Popularisation in Pre-Independence India* (New Delhi: Vigyan Prasar, 2000).

30 This point was made already in 1972 by Walter Rodney in his classic pamphlet *How Europe Underdeveloped Africa* (London, Bogle-L'Ouverture Publications, 1972); See also Susantha Goonathilake, *Aborted Discovery. Science & Creativity in the Third World* (London: Zed Books, 1984).

outside the Western sphere of influence. Western scholars have researched at large colonial or imperial science, but there have been few works on local scientific traditions which do not take colonial rule or Western hegemony as their point of reference.[31] But it is important for every citizen that science is part of his/her history and that the current global spread of science will only succeed if local populations find their own place in the spotlight.[32]

Provincializing Western science

In 1993, the Canadian historian of science, Lewis Pyenson, an authority in the history of colonial science, wrote that the history of science "emerged early in the twentieth century as a defender of the West."[33] As Europe was losing ground with respect to global newcomers like the United States and Japan, European intellectuals sought means to justify Europe's "rapacious conquest of the word" by pointing to the uniqueness of its science. European science was superior to other systems of thought, and was the only type of knowledge that could be considered to be universal. For this argument to be effective, European science had to be labeled unequivocally as European (or at least Western). Many of the early historians of science therefore neglected contributions from other civilizations to Western science, and focused on the revolutionary difference between earlier versions of natural philosophy versus Newtonian experimental physics.

Pyenson bases his argument mainly on the work of Paul Tannery (1843-1904) and some of his sources and contemporaries, but he has a point in seeing a continuity between the generation of Tannery and the establishment of the history of science as a discipline.

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31 An historiographical attempt exploring the history of science "beyond the encouragement of Euro-American historiography" is Jahnavi Phalkey and Tong Lam, "Science of giants: China and India in the twentieth century," *British Journal for the History of Science. Themes* 1 (2016) 1-11.

32 Some books who approach the story from a local and/or precolonial point of view: Zaheer Baber, *The Science of Empire. Scientific Knowledge, Civilization, and Colonial Rule in India* (New York, State University of New York Press, 1996); Miri Shefer-Mossensohn, *Science among the Ottomans. The Cultural Creation and Exchange of Knowledge* (Austin: University of Texas Press, 2015); Stuart McCook, *States of Nature. Science, Agriculture, and Environment in the Spanish Caribbean, 1760-1940* (Austin: University of Texas Press, 2002); Fabiola López-Durán, *Eugenics in the Garden. Transatlantic Architecture and the Crafting of Modernity* (Austin: University of Texas Press, 2018).

33 Lewis Pyenson, "Prerogatives of European intellect: Historians of science and the promotion of Western civilization," *History of Science* 31 (1993) 289-315 (quotation on p. 290).

> When in the late 1920s the discipline cast about for a form to broadcast its ideology, settling on an international academy, the Western vision received canonical expression. Among the twenty-two founding academicians, six were from the United States. Several men were specialists of classical Antiquity and the Islamic world, but they viewed things from a European perspective; no scholar focused exclusively beyond Mediterranean lands."[34]

Whether or not the history of science was consciously set up to defend the West against upcoming competitors, the discipline was founded in Western Europe and the United States, and as such it bore the mark of the Western culture it which it was embedded. The profile of the discipline was further enhanced during the Cold War, when Western science was put against what was considered the totalitarian and ideological approach implemented in the Soviet Union. The central concept which came out of this episode was the Scientific Revolution, the seventeenth-century transformation of natural philosophy into a physico-mechanical worldview, exemplified by the work of Alexandre Koyré (1892-1964).[35] The Revolution was entirely European, more inspired by Greek Antiquity than by any other civilization. The story could, and indeed was, told without any reference to what happened outside of Europe. For several generations, including mine, It would become the main narrative to understand the nature of modern science. Increasingly, it is seen by recent historians as being one of the main stumbling blocks in constructing a new global and comparative narrative.[36]

Is it possible to write a history of science without reference to the European Scientific Revolution? Probably not. The revolution was real, the change in world view was fundamental, the development of new technologies and methodologies proved to be crucial in the formulation of new knowledge, and its consequences were profound in changing the intellectual landscape of the Western world. But at the same time it can be wondered how far these revolutionary developments have played a significant role on a global scale. To communities of scholars in other continents, the clash between scholastic philosophy and Newtonian physics does not seem very relevant.

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34 Pyenson, "Prerogatives," p. 306-307.

35 H. Floris Cohen, *The Scientific Revolution. A Historiographical Inquiry* (Chicago: The University of Chicago Press, 1994). For a different interpretation of the origin of the Scientific Revolution (in a somewhat different meaning) see James Secord, "Inventing the Scientific Revolution," *Isis* 114 (2023) 51-76.

36 Kapil Raj, "Thinking without the Scientific Revolution: Global Interactions and the Construction of Knowledge," *Journal of Early Modern History* 21 (2017) 445-458.

Much of the scientific knowledge produced in the West before 1800 had little practical applications. Its role (if any) in the Industrial Revolution is still a matter of debate.[37]

To adapt our grand narrative of scientific development to the current challenges of global science studies, we need to reconceptualize the basic notions of science and knowledge. First, as Peter Dear has argued, our common understanding of science as it developed in seventeenth century Europe is actually an unstable construct of at least two different conceptions of natural knowledge, a conflagration of contemplative natural philosophy and a more practical brand of useful, instrumental knowledge.[38] Dear's distinction can be further elaborated to distinguish at any moment in history different coexisting knowledge regimes, which all contribute the grand reservoir of knowledge available to communities.[39] Historians of science have a tendency to reduce the complexity of knowledge systems to a central core of concepts, which have been formed around the European system of structuring valid knowledge. We need to reopen that closed box of what is considered 'scientific' in order to let in a more diversified picture of what constituted (and still constitutes) trusted and robust knowledge. Approaches in this direction have been attempted, although often with reference to (and thus subordination to) the central notion of science: we have now indigenous science, artisanal science, commercial science, the science of engineers or medical practioners, the knowledge produced and preserved by women, the knowledge of artists, the scientific conversations

37 Joel Mokyr, *The gifts of Athena. Historical Origins of the Knowledge Economy* (Princeton: Princeton University Press, 2002); Maxine Berg, "The genesis of 'useful knowledge'," *History of Science* 45 (2007 123-133.

38 Peter Dear, "What Is the History of Science the History Of? Early Modern Roots of the Ideology of Modern Science," *Isis* 96 (2005) 390-406. See also his discussion of distinct knowledge epistemologies in Peter Dear, *Revolutionizing the Sciences. European Knowledge and its Ambitions, 1500-1700* (Houndmills: Pallgrave, 2001).

39 My own understanding of the social nature of science is based the social epistemology developed in the context of science communication, in particular risk communication. See Miika Vähämaa, "Groups as epistemic communities. Social forces and affect as antecedents to knowledge," *Social Epistemology* 27 (2013) 3-20.

in the market place…[40] Every one of these knowledge systems can be defined as autonomous, systematic and legitimate ways of dealing with problematic issues confronting the communities concerned. The history of science needs to come to terms with this plurality of 'sciences'. Instead of describing the emerging stages of the hegemony of Western science, we need to pay more attention to the knowledge systems which are grounded in communal practices and which for good reasons did not disappear under the hegemony of our Western scientific system.

If the history of science can be reconceptualized as the history of coexisting knowledge systems, we also need to consider the destructive powers that may be at work in the confrontation between these systems. When science enters a field of practices in which knowledge is already well developed, one logical consequence that can be expected to happen is the delegitimization of competing systems of knowledge.[41] The introduction of science then acts as a producer of ignorance, in as much as the holders of (non-scientific) knowledge are now considered to be ignorant (of scientific knowledge).[42] In the process, much valuable information and experience may be thrown away. Also, the replacement of expertise in favor of science often obscures the hidden powers of state and industry in setting up the new knowledge regime.[43] But as becomes apparent from Sheila Jasanoff's work of co-production of science and social order, it is impossible to write a history of science without considering its implications for the organization of society and political relatiions.[44]

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40 Alice Cooper, *Inventing the Indigenous. Local Knowledge and Natural History in Early Modern Europe* (Cambridge University Press, 2007); Pamela H. Smith and Paula Findlen (eds.), *Merchants and Marvels. Commerce, Science, and Art in Early Modern Europe* (New York and London: Routledge, 2002); Harold J. Cook, *Matters of Exchange. Commerce, Medicine, and Science in the Dutch Golden* Age (New Haven: Yale University Press, 2007); Hélène Vérin, *La gloire des ingénieurs. L'intelligence technique du XVIe au XVIIIe siècle* (Paris: Albin Michel, 1993); Carolyn Merchant, *The Death of Nature. Women, Ecology and the Scientific Revolution* (San Francisco: Harper & Row Publishers, 1980); Susanna Berger, *The Art of Philosophy. Visual Thinking in Europe from the Late Renaissance to the Early Enlightenment* (Princeton University Press, 2017); Brendan Dooley, *Science and the Marketplace in Early Modern Italy* (Lanham: Lexington Books, 2001).

41 One example of this are the debates between science and religion.

42 This may lead to disastrous results, e.g. when the nature of 'scientific' expertise is unclear or even contradictory. See e.g. Bethany L. Johnson and Margaret M. Quinlan, *You're doing it wrong! Mothering, Media, and Medical Expertise* (New Brunswick: Rutgers University Press, 2019).

43 Bert Theunissen, "Breeding for nobility or for production? Cultures of dairy cattle breeding in the Netherlands, 1945–1995." *Isis* 103 (2012) 278-309.

44 Sheila Jasanoff (eds.), *States of Knowledge. The Co-Production of Science and Social Order* (London and New York: Routledge, 2004).

The history of science needs to include the various knowledge traditions which are in conversation with the dominant scientific community. Any outcome of such a confrontation needs always to be considered as temporary dynamic and unstable. This also implies that historians of science need to take some distance from the 'scientific' point of view, sometimes even from the 'rational' or 'modern' understanding of a situation. In considering the weight of the tradition that has to be cast off, it may be necessary to consider the history of science from a subaltern position, which may threaten the neutrality of the history in relating and interpreting the 'facts'. Sandra Harding has argued for "strong objectivity", which transcends the mere neutrality requirement of 'weak' objectivity to address collective assumptions and ideological constructions among researchers which actually block their ability to produce a complete and undistorted account of nature and social relations.[45] Strong objectivity leads to standpoint epistemology, in which history is considered and understood from the standpoint of "marginal lives". "If one starts from the activities of those who are necessarily disadvantaged in a particular kind of social order one can come to understand objectively existing features of it that are much harder to detect when one starts from the activities of those who benefit most."[46] In as much as Western science has gained dominance in the global world of knowledge, we urgently need standpoint histories from non-Western perspectives to escape the trappings of prejudice and blindness.[47]

The challenge for historians of science is to construct a new master narrative which would transcend the European circumscription and have relevance for a global science movement. Attempts are being made by using the processes of global connectedness, transnational history, circulation of knowledge, or plural histories as primary tools.[48] In order to be successful, these efforts will need to enlist international audiences from diverse communities, and it will require historians to broaden their horizon beyond the

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45 Sandra Hardin, "After the Neutrality Ideal: Science, Politics, and 'Strong Objectivity'," in: Margaret C. Jacob (ed.), *The Politics of Western Science* (New Jersey: Humanities Press, 1992) 81-101.

46 Harding, *op.cit.*, p. 98.

47 See also Joe Curnow, "Resituating situated learning within racialized and colonial social relations." *Mind, Culture, and Activity* (2022): 1-15.

48 Kapil Raj, *Relocating Modern Science. Circulation and the Construction of Knowledge in South Asia and Europe. Seventeenth to Nineteenth Centuries* (Delhi: Permanent Black, 2006); Sujit Sivasundaran, "Sciences and the Global. On Methods, Questions, and Theory," *Isis* 101 (2010) 146-15; Simone Turchetti, Néstor Herran, Soraya Boudia, "Introduction: have we ever been 'transnational'? Towards a history of science across and beyond borders," *British Journal for the History of Science* 45 (2012) 319-336; J.B. Shank, "Special Issue: After the Scientific Revolution: Thinking Globally about the Histories of the Modern Sciences," *Journal of Early Modern History* 21 (2017) 377-393.

scope of European languages of European referential systems of thought. If that is not possible, we cannot have a true history of science. For, in the words of George Sarton, the history of science "is the history not only of ourselves and our friends, our province, our country, our continent or our race, but of all countries, of all peoples, North and South, East and West."[49] It is time we take this message by heart.

[49] Sarton, *New Humanism*, p. 125.

Laudatio Louise Fresco

Monica Höfte

As the Proxima and Chair of the Department of Plants and Crops, it gives me great pleasure and honour to introduce Louise Fresco. She has been nominated for the Sarton Chair on behalf of the Faculty of Bioscience Engineering of Ghent University. For many of you, Louise Fresco needs no introduction as she is a well-known writer, scientist, and manager in the field of sustainable agriculture and food systems. Recently, she gained significant media attention in Belgium due to her latest book, "Ons voedsel: een levenslang verhaal" (translated as "Our Food: a Lifelong Story,") which explores the inspiring tales behind every meal with an optimistic outlook.

For those of you who do not know her, the easiest way to find out is to ask ChatGPT:

Who is Louise Fresco?

Excerpts of the answer I got*:*

Louise Fresco is a Dutch scientist, academic, and writer. She is best known for her work in the field of sustainable agriculture and food systems, and for her contributions to the understanding of the relationship between food, the environment, and human well-being.

In her writing and public speaking, Fresco emphasizes the importance of taking a holistic and interdisciplinary approach to understanding and addressing the complex challenges facing our food systems, including the need to balance economic, social, and environmental concerns.

Not so bad I think..

But Louise Fresco is much more than that. In preparing this laudation I discovered a brave and fascinating woman of many talents and interests: writer, columnist, literary critic, polyglot, scientist, engineer, university teacher, manager, negotiator, art lover, historian and amateur musician.

To illustrate her talents: some quotes from former colleagues and collaborators that I found in the journal RESOURCE (for students and employees of Wageningen UR) “the joke about people like Louise Fresco is always that you need to go after them with a vacuum cleaner to collect up all the good ideas (Jetse Stoorvogel). “She is terribly good at presenting things and brainstorming” (Martin van Ittersum) “She has a good nose for what is going on, for new developments” (Tom Veldkamp) “She looks at agriculture as a whole, with processes going on at different scale levels” (Paul Struik) “Fresco is adverse to dogma. She wants to use all the available knowledge in the service of her ideals” (Rudy Rabbinge).

One remarkable aspect of her is that she refuses to be labeled or categorized. In fact, she admits that she values nuance and perspective more than taking a firm stance on any given issue. Her approach is to seek out a comprehensive understanding of complex topics rather than simply adopting a single, rigid viewpoint.

A look at her biography shows the many faces of Louise.

Louise was born into a sheltered and cultivated middle class family in Meppel in the Netherlands. But most of her youth was spent abroad, notably in Belgium. She lived in Uccle near Brussels, in a house full of books and magazines. She attended the international high school in Uccle where her father was teaching philosophy. It is in this house that she decided to study tropical agriculture after seeing pictures of the famine in Biafra in a Paris Match magazine in 1968.

Between 1970 and 1976, she pursued her studies in non-western rural sociology at Wageningen University. During this time, she had an insatiable thirst for knowledge and took courses in a diverse range of disciplines, including plant production, soil science, remote sensing, tropical animal husbandry, human nutrition, anthropology, and social sciences. For her Master’s thesis, she conducted research in Zambia, where she studied households and women in a changing rural society. Upon completing her studies, she worked as a UN volunteer in Papua New Guinea for two years,

and subsequently held a field position as a project manager for the FAO in Congo from 1979 to 1983.

She received her PhD in tropical crop science from Wageningen University in 1986 about "Cassava in shifting cultivation: a systems approach to agricultural technology development in Africa".

From her stays in developing countries, she gained a firsthand understanding of what it means to experience **food shortages**.

After her PhD she build a successful academic career and was a professor in tropical plant production systems and chair of the Department of Agronomy at Wageningen University from 1990 to 1997. During that period, she introduced many interdisciplinary course elements in plant production, soil science and social sciences and conducted extensive field work in Spain, West Africa and Latin America. She also started to take up management positions, such as chairing the National Council for Environmental and Nature Research and participating in many national committees. She was also a member of several international boards such as the board of CGIAR centres. Notably is her promotion of innovative research on indigenous rice varieties in Africa leading to the development of **Nerica** rice, interspecific hybrid rice developed by the Africa Rice Center (WARDA) to improve the yield of African rice cultivars. She also developed an interest in the effect of climate change on vegetation and land use.

Her career in the Netherlands taught her about **efficient food production**.

In 1997 she decided to leave Wageningen University and move to the field of management. She became director of Research, Extension and Training Division at the Food and Agriculture Organization of the UN in Rome. In 2000 she was promoted to assistant director general of the Agricultural Department of FAO. She implemented major reforms using all her skills as a negotiator.

She lived in Rome for about 10 years. In Italy she learned about the **culture of food** in all its complicated richness.

She resigned from her position at FAO in Rome in 2006 in reaction to the continuous budget cuts and a boss who did not want any change. She returned to the Netherlands and to academics and became a professor of "Foundations of sustainable development in international perspective" at the University of Amsterdam without administrative and teaching obliga-

tions. This position gave her the freedom to work on her magnum opus: Hamburgers in het Paradijs" (Hamburgers in Paradise: the stories about the food we eat), a non-fiction book about food and agriculture in times of scarcity and abundance.

From 2009 to 2014 Louise was supervisory director of Rabobank gaining first hand experience in the private financial sector. She was also a Crown appointed member of the Social and Economic Council of the Netherlands, stepping down in 2014.

In 2014 she returned to the field of management and became President of the Wageningen University and Research Executive board. She has held that position until her retirement in June 2022.

She is or has been member of various advisory boards and has a long list of positions and prizes. To note just a few: From 2009 to 2014 Louise was supervisory director of Rabobank gaining firsthand experience in the private financial sector. She was also a Crown appointed member of the Social and Economic Council of the Netherlands, stepping down in 2014. She was a non-executive director at Unilever from 2009 until 2017. Currently, she is an independent non-executive director at Syngenta. She is on the advisory board of the World Food Prize foundation and member of several scientific Academies, such as the Royal Netherlands Academy of Arts and Sciences (2009), the French Academy of Agriculture (2012), the Royal Swedish Academy of Agriculture and Forestry (2000), a foreign member of the Royal Flemish Academy of Belgium for Science and the Arts, Class of Natural Sciences (since 2016) and corresponding member of Belgium's Royal Academy of Overseas Sciences (2014), just to name a few.

She received an honorary doctorate from the KULeuven and the Université de Liège in 2017, from the Hebrew University in 2019 and from the Université de Montpellier in 2020.

Besides her career in science and management, Louise has a life-long commitment to science communication, and literature. She writes biweekly columns in NRC, a Dutch quality newspaper, about a variety of subjects. She has written several non-scientific novels and 4 non-fiction books. She is also a literary critic and art lover reflected by positions such as chair of the selection board of the Johannes van Dam Prize and Board Member Foundation of the Dutch National Opera & Ballet Fund (2018)

In our polarized world, Louise's voice, optimistic tone, belief in knowledge and technology, and aversion of dogma is refreshing. I recommend reading her books to learn about her views on agriculture and the future food supply and I am looking forward to her lecture of today.

Three Dichotomies in the History of Food and Agricultural Sciences

Louise O. Fresco

From the outside, universities and places of higher learning have long appeared as formidable ivory towers of knowledge. Scientific insight, by which I mean knowledge in the broadest sense, including the humanities, somehow seemed to emerge, spontaneously, through genius and serendipity. It is as if somewhere, a universe of scientific ideas and laws lays waiting to be uncovered, for the patient scientist or scholar.

The reality of discovery is usually more prosaic: coincidences, mistakes, curiosity, or dogged patience have led to major breakthroughs. Think of the iconic discovery of penicillin by Alexander Fleming in 1928, due to a poorly cleaned, mouldy petri dish which he found in his lab after returning from holidays. Timing was the essence of his serendipity: would he have returned earlier, the anti-bacterial mould would not have developed sufficiently, and he would not have noted anything odd.

But there is more to the discovery of scientific insight alone. Beyond coincidence and good luck, individual and collective visions of the world have always played a role in the choice of what to investigate and in the interpretation and applications of the results. Therefore, knowledge is not neutral, but a deep reflection of the time. Certainly in democratic countries, these views of the world vary and may clash. This is a good thing. The divergence of views leads to debate and shapes how knowledge comes into being. This is the essence of academia. I would like to underline this, because the current perception in society sometimes seems that debate is a sign of weakness, scientific or otherwise. Academic debate does not develop in isolation. It brings us forwards. Think of the intense personal rivalry

between Louis Pasteur and Robert Koch. Their work on bacteriology was complementary in many ways, but became part of the political tensions between France and Germany after the 1870 war. Their subsequent work on cholera in Egypt, where Koch was faster than Pasteur, also shows how much they were part of the expanding western colonization.

So let us explore the influence of personal and political world views a little more. Where appropriate I will use illustrations from my own very broad field of environment, agriculture and food with its intertwining of fundamental and applied biological, medical, economic, and sociological knowledge. I propose to structure my lecture around three very different dichotomies of world views.

You may be familiar with the first one. “The hedgehog knows only one big thing, while the fox knows many things”. In 1953 the philosopher Isaiah Berlin revived this distinction originally voiced by Archilochus to discuss his views on Tolstoy. Foxes pursue reality in its manifold, pluralistic and sometimes contradictory manifestations, while hedgehogs believe in the unity of all. Think Dostoevsky or Plato as hedgehogs, versus Pushkin or Aristotle as foxes. Of course, this is an extreme simplification of how ideas really develop over the life of an intellectual. Berlin himself had difficulty to fit his favoured author, Tolstoy, in the mould. According to Berlin, Tolstoy was a fox by nature but convinced himself that he was a hedgehog, that only one big idea should guide him in his writing: the limits of rationality.

One could imagine that George Sarton himself would fall in the same category as Tolstoy: a fox who convinced himself he was a hedgehog. Someone with a broad curiosity and an enormous knowledge, willing to be led astray in medieval Christian and Arabic philosophy for his study of Leonardo da Vinci. But what motivated Sarton, I would venture, was his overriding mission to establish history of science as a grand field applicable to all disciplines, epochs, and geographies. In that sense he was a hedgehog moving with patience and determination in a single direction.

I find Berlin’s dichotomy, even if it was meant as an intellectual divertimento and to be applied at writers and philosophers, helpful to look at individual scholars who shaped my field. The prime example that springs to mind is Darwin. Darwin was a fox, obviously. But again, a fox who also grew into pursuing one overriding idea, that of evolution through natural

selection as a force without aim or destination. An outcome whereby Man, the human species, was not necessarily the intended nor final culmination, nor created by a divine hand. It rocked the foundation of religious faith.

Another example, contemporary to Darwin, concerns Justus von Liebig. This German founder of organic chemistry was a fox as well, but a hedgehog in his meticulous and extensive research in each of his chosen subjects. He invented chemical fertilizers as a replacement for manure, proving that the then popular humus theory was wrong. Plants do not get their carbon from dead leaves, but from photosynthesis. At the same time, he also developed a way to extract meat through evaporation which turned out to be extremely nutritious for the sick and the wounded. This led to the Liebig stock cubes that you all are familiar with. Von Liebig was able to apply his intelligence to any subject that came his way. Had he lived today, he might have been a molecular biologist.

This allows me to pay tribute to one this university's eminent hedgehogs, if I may say so, Marc von Montagu. His work on Agrobacterium as a delivery mechanism was the first proof of concept in the genetic modification of plants. Notwithstanding the public reluctance to accept transgenic plants (and I will return to this later), his work has found widespread application in world agriculture and contributes significantly to making it more sustainable. In looking at the broader picture, across his long career, he slowly became more and more of a fox.

I could give you many more examples of hedgehogs and foxes – but suffice to say that the history of great science is populated with devoted hedgehogs who mostly were foxes by nature. However, the current university systems are more conducive to hedgehogs than to foxes. Most scientists, I mean those working in universities or research institutes, must now be classified as hedgehogs. They nurture a single leading view of their discipline. They focus on a singular way to see the world, be it through the lens of pathogens, hydraulics, psychology or whatever. Often hedgehogs are enormously successful in their discoveries. However, it is the fox who accumulates a multitude of views and experiences in order to constitute a kaleidoscopic perspective of the world bringing about the real societal change. Regretfully, in some ways, we seem to enter an era of fragmented, highly specialised knowledge in academia. Few people can afford to specialise in more than one field, let alone excel in the scientific rat race by pursuing too many interests.

One might wonder how George Sarton would have viewed the current state of affairs. That Leonardo da Vinci was his model, if I may use this word, doesn't surprise me. Leonardo was the ideal constructor of the world, as a scientist, an artist, an engineer. The uomo universalis is a figure that is unthinkable in the 21th century. Leonardo, one could argue, would have been a fox, driven by the ultimate idea of shaping the world.

It is exactly this ideal that seems elusive in our time. There are no more Leonardi: a uomo universale would not fit the mould of a modern university education, he or she would not today's pass the severe peer reviews. Worse, the refusal to specialize, let alone to choose between science and art, or to produce results with impact, would be a recipe for disaster and outright rejection. Hence, Sarton, would he have known about Berlin's distinction, would squarely have placed Leonardo in the category of foxes. Leonardo was perhaps the superfox of them all.

So, we have foxes and hedgehogs and although most scientists, certainly in my field, are hedgehogs, we could argue that the broader vision of the foxes makes disciplines move forward. However, the foxes need the hedgehogs, because many scientific breakthroughs are based on the painstaking work of the hedgehogs.

Does this matter? Indeed, it does, certainly for food and agriculture! It is true that many of the advances comes from the hedgehogs. But what is also needed today is the integration of new understanding into the design of sustainable food and agricultural systems that produce nutritious, safe and affordable food for all. And for that integration we need the foxes, the holistic thinkers. Let me illustrate this with the case of "golden rice". This is a genetically modified variety of Asian rice that includes a precursor of vitamin A, hence its yellow or golden colour. It was intended to help prevent blindness and decrease the risk of child mortality due to diarrhoea. As the first genetically modified food crop with obvious nutritional benefits, expectations were high. However, the concerns and critique grew rapidly. Some of these came from groups principally opposed to genetic modification or invoking food safety. Other comments were more practical: it would be preferable to promote the growing of vegetables, give out food supplements, or include them in existing foods. The golden rice was approved by regulators, the commercial developer was ready to waive royalties for small farmers, but it never became a true success because of a failure to include the social,

economic and political dimensions in the research. It needed the broad view from a fox who wanted more than a successful gene construct.

Let me now turn to a second dichotomy, this one probably unknown to most of you. It is rooted in the field of food and agriculture and pits the Prophet versus the Wizard. This distinction was formulated recently by Charles Mann, a known historical journalist. In contrast to the other two dichotomies, it is based on two historical figures, ecologist William Vogt and geneticist Norman Borlaug. They were both Americans who worked during the 1930^{s} and 1940^{s} to solve the big questions of their time such as population growth, food, resource depletion and nature. The prophet was Vogt, expressed profound pessimism about the future. Only if consumption and population would be curtailed rapidly, humanity would stand a chance to survive. He was, in other words, the father of the radical and frequently apocalyptic environmental movements. Charles Mann contrasts Vogt with the wizard Norman Borlaug, plant breeder and father of the Green Revolution. His improved varieties of wheat and maize are credited to possibly have saved a billion people from famine.

Their intellectual descendants still clash continuously and violently. The prophets are against genetic modification, international trade and big business, and espouse small scale, organic agriculture. The wizards see a world to win through biotechnology and high-tech applications, also in poor countries. Most fiercely, they differ on climate change. The wizards are excitedly pursuing carbon capture in agricultural soils, whereas the prophets want an immediate reduction of greenhouse gas emissions. The dichotomy between the wizard and the prophet is played out in the public arena as the polarization between the technocrats and the doomsayers. The former believe technology to be a solution for every ill, the latter are convinced that the technocratic fix is leading us even faster into the abyss.

In the field of food and agriculture, governments and parliaments prefer to accept the pessimistic advice from non-governmental organisations or only accept a selection of scientific facts that suit their world views. Again, the question is, does it matter? Yes, it does. The polarisation resulting from the positions of the prophets and the wizards leads to unclear, wavering policies and piecemeal decisions. Given the fact that we would like to keep as much land as possible for natural ecosystems and carbon storage, concentrating food production on suitable land with the most efficient use of resources and application, this requires decisive government action. My

ultimate hope is that in the future intensive food production will combine elements of various schools of thinking such as organic, agro-ecological, regenerative and precision farming.

There is yet a third dichotomy I would like to present, one that you may be familiar with. This one was formulated only a few years after Isaiah Berlin, by C.P. Snow. Snow was a British senior civil servant, a scientist, and a writer – an unusual combination then and now, and vaguely reminiscent of Leonardo da Vinci in his crossing of boundaries, but obviously without the artistic genius. In 1959 he pronounced his famous Rede lecture in Cambridge, called The Two Cultures and the Scientific Revolution. In his speech he emphasised the gap between scientists and the rest of educated society by demonstrating that scientists balked at Dickens or Shakespeare, whereas the literary class had no idea of the Second Law of Thermodynamics. For Snow, asking his interlocutors from the humanities about the meaning of concepts like mass or acceleration was the equivalent of asking: are you able to read? Yet the response he drew was cold or even negative. At that time, more than sixty years ago, the natural and engineering sciences were rapidly gaining ground thanks to the discovery of the hitherto unimaginable big and small scales (the depth of universe and the subatomic). Yet most intellectuals, a term then reserved for the humanities, had no clue about the magnitude and impact of the sciences in their day-to-day life, let alone in shaping future social order.

Disdain, apathy, and misunderstandings between the two groups abound until today. Most students of biology or physics still ignore what the Era of Enlightenment is about (although it laid the ground for the intersubjective verification of scientific methods that they benefit from every day). Conversely, for most people in the humanities not just the second law of thermodynamics but the basics of evolutionary selection or photosynthesis remain inaccessible, then and now. As Snow put it: “So the great edifice of physics goes up, and the majority of the cleverest people in the western world have about as much insight into it as their Neolithic ancestors would have had.” The gap between the Two Cultures was an immediate threat to society and progress, according to Snow. Because literary figures, politicians and civil servants had no idea about science, they were unable to come up with true solutions to the urgent questions of the time.

Georges Sarton himself had already noticed this gap. Nearly 30 years before Snow he expressed his concern as follows: “The intellectual elite is

at present divided into two hostile groups – which we may call for short the literary and the scientific – who do not speak the same language nor think in the same way. If nothing is done, then the gap separating them must necessarily increase, together with the steady and irresistible progress of science." However, he was far more optimistic than C.P. Snow. Sarton felt that good will on both sides would help, and he saw himself as someone contributing to bridging the gap.

Fast forward to today, and the gap between science and the humanities is even more noticeable. In crucial matters such as nuclear energy, modern genetics, or geo-engineering there is a profound unwillingness to engage in a dispassionate, objective dialogue. The exact sciences are not a favoured career path, with the exception of a few nerdy individuals engaged in computer science and start-ups. The majority of high school students who have completed their A-levels in science, prefer a career in social or political sciences, business or law.

Unfortunately, Snow's Two Cultures analysis does not stop here. Currently, we are confronted with a subsidiary dichotomy, between the culturally literate and illiterate: "From two cultures to no culture" according to the telling title of a set of essays celebrating the fiftieth anniversary of Snow's speech. Today, the gap is not only between science and the humanities but also between those who read widely and have a basic understanding of matters outside their immediate experience and those who do not. This is in part the result of an education system that prioritises what children like to do, not what they should learn. The choice at school is not about Darwin or Dante but about PlayStation and TikTok versus cultural history in the broadest sense.

The effects of No Culture are even greater than those of the Two cultures. As in Snow's time we must be concerned about the rejection of scientific methods and progress by the middle classes and certain intellectuals. But on top of that, we should worry about the profound lack of historical and cultural perspectives that results from little or no exposure to art. Those who never familiarise themselves with art and literature have no idea of the profound dilemmas facing individuals and societies through human evolution, both social and technical. Understanding relations of power, corruption and empathy but also understanding humanity's mastery of an inherently indifferent and dangerous ecological environment are essential for progress.

One thing has changed since Snow: the fear of figures and data has transformed into the highly selective use of quantitative information. Models are now the favoured tool of policy makers, but few of them understand that the figures generated by models are the outcome of assumptions and not necessarily facts, certainly not if the model has not been validated with independent field data. Figures and model scenarios may be popular rhetorical instruments in politics, unfortunately their use in common language is fraught with difficulty. Often, they are used in a metaphorical sense. For example: processes, such as demographic growth, are erroneously called "exponential' these days. In fact, nowhere is human population increasing exponentially, and what is meant is probably "very much" or "worrisome". This is symptomatic of a Snowian confusion of the literary metaphor with scientific exactitude. What is crucially lacking in today's debate is a sense of orders of magnitude. Who thinks that CO_2 is a substantial component of the atmosphere instead of a trace gas, misses a fundamental dimension. Slowly, in the last decade facts have been replaced by partial information and opinions.

And perhaps even worse is the tendency towards fact-free opinion making, journalism and debate, bordering on the irresponsible. The core of the Enlightenment, questioning received knowledge and replacing it with individual reason has turned into a No Cultures bias. Every individual now sees himself or herself as a source of unique knowledge, forgetting that Enlightenment meant a lifelong commitment to questioning and learning. The public happily engages in debates arguing that all meat consumption should be banned to combat climate change or that fertilizer is killing the soil, supported by little if any research. I cannot emphasize enough that everyone has the right to his or her opinion, but that one does not have the right to one's own facts.

The difference with the 1950^{s}, when C.P Snow asked his famous question about thermodynamics is that today intellectuals in the humanities, and many citizens, do have an inkling of the role of science and technology. They are aware of the enormous effects of the application of science on their daily lives. Internet, modern medicine (vaccines!), energy and transportation have a visible role today. Yet that awareness is selective and often vague: most people would be surprised to hear that Einstein's theory of relativity is necessary to correct the navigation in their cars. Conversely, many worry about areas they know little about, such as vitamins or calo-

ries, being at a loss to distinguish more than a few vitamins or minerals or to know their true effects.

In the last decades knowledge is increasingly considered a public investment which should prove its immediate usefulness to society. Governments are willing to spend considerable sums of money on say green energy. I am not saying that the importance of knowledge for progress was overlooked in the past, but the current perception in society and among politicians is that universities are supermarkets where one may pick the desired results. Academics are asked for stunning innovations. While the calls for clear-cut, immediate solutions grow louder, the learned inhabitants of the academic tower have not always delivered the desired results. And what is worse, they have sometimes fed public confusion by coming up with contradictory or inconclusive results. Academic fights spill over into politics and economics. Is nuclear energy safe? Or genetic modification? Is sugar dangerous? Should organs from pigs be used for humans? Is 2050 really a point of no return for climate change? As worries about the future of the planet grow it becomes clear that controversies and polarisation are part and parcel of mature, knowledge-led democracies.

Media have a role here too. Few journalists ask critical questions about the methodology of studies that come with spectacular results, or about the assumptions behind the models that predict the most terrible scenarios for our future. The temptation for scientists, even if they are not prophets by nature, to present doomsday scenarios is great. It is a way to attract attention and hence funding in a fiercely competitive world. But it seems to me that the price is high. Too high perhaps. Of course, we should not return to the ivory tower of science from where no scientist dares to descend.

Yet, obviously, involving citizens and fellow academics in other disciplines to build broad consensus is necessary. However, science is not like politics. The truth does not lie is the middle and is not a compromise, but the result of a self-cleansing system of peer review. But where researchers succumb to the temptation to speak out about other than their own disciplines, confusion starts to reign. Who to believe? Increasingly, one encounters human psychologists who feel they have to say something about animal welfare, or sociologists who want to redesign the food chain without a true understanding of the economical or chemical processes behind their proposals.

I conclude that we have three intersecting sets of dichotomies that may explain some of the differences in world views between scientists, disciplines, society and politics. There is a disconnect between what society asks from academia and what academia can deliver because of the rigid funding structures and the drive towards specialization. In academia there are too few foxes among the many hedgehogs. The number of prophets is increasingly vocal. Society is more sensitive to the prophets than to the wizards. But most importantly perhaps, society is more and more in the grip of "no culture" or a profound lack of historical perspective and understanding of how knowledge is developed.

So indeed, perhaps we do need another uomo universale, or una donna universale, or even another George Sarton who can show us through the depth of history how scientific thought evolves. As I argued, the uomo universale is unthinkable today. However, we could allow students and academics more room to explore other fields beyond their disciplines to nurture more foxes and develop an ongoing dialogue between the wizards and the prophets and between the humanities and the sciences. Such a dialogue matters. Differences of opinion are the meat of scientific progress. But divergent world views in society now seem to lead to a stalemate that can hardly be broken. Politicians do not dare to take decisions because there is always a group who points to risks, there is always a scientific study that suggests more work needs to be done. I only need to point to current crisis on nitrogen in Belgium or The Netherlands.

Outside of the realm of science, society profoundly divergent world views are now common good. Public understanding of scientific progress and the remaining questions is not increasing and even declining. There seems to be a breaking apart along deep fault lines. The most pervasive difference is between those who are optimistic about the future and those who are not. We see a mixed group of young people, of whom Greta Thunberg is the most vocal, who express dismay at what they perceive as the failure to act on climate change and who accuse the previous generations of selfishness and inertia. They feel the private firms in energy, agriculture and food, helped by the government, are potentially poisoning us. There is another large group, possibly the majority, who are concerned and sometimes downright pessimistic about the future, but still feel they will not suffer personally, and behavioural change is not their individual priority. These two groups

stand in contrast to a smaller, well-educated optimistic segment, those who believe in innovation and the power of technical advances.

Let me admit it. I am a hedgehog at heart. I believe the one big thing, that human ingenuity creates progress, that collectively, we learn from our mistakes and that gradually we are making the world a better place where food will be nutritious, safe, sustainably produced and affordable, where peace will prevail. But I am also a fox, because to pursue these things, we need many new ideas. I am a wizard when it comes to my conviction that science is the basis for progress. Without its results – electricity, fertilizer, antibiotics, food preservation, better genotypes etc. – we would still be miserable and poor. I am a prophet because I am convinced that the destruction of natural habitats is damaging ecosystem cycles, even if I also think nature is far more resilient than most prophets want to believe. And although I know my Shakespeare, I certainly am also familiar with the First and Second Law of Thermodynamics. And I think everybody should be, not least politicians.

Debate is the essence of academia, as I indicated earlier. With too many specialized hedgehogs the room for debate about the grand questions of our time is declining. At the same time, the gulf between prophets who feel nature is worth more protection than food production, and wizards who concentrate on ever advancing technology, is widening. And last but not least, the poor public understanding of how science works, including basic statistics, leads to the confirmation of world views where science seems at best just an opinion, or at worst part of a plot against humanity rather than a force for the common good.

For the wider issues of food and agriculture, and for technology-based progress we must move out of the current deadlock. We cannot return to the past. Let's put the best of our knowledge at the service of those who most need it. We will make mistakes, but we will correct them, because academia is the best environment to manage our doubts and redress misconceptions. Knowledge is not the answer to every issue, but it is the conditio sine qua non for progress. Everything around us is the result of the better understanding we have of the laws of physics, chemistry, and biology and how they can be applied in an economic, sociological and political context.

Scientific knowledge about the world, that unique planet in an inhospitable, indifferent universe, is insufficient for human fulfilment. In the end, it

is art that gives life meaning. So let me conclude with a quote by Georges Sarton himself at the award ceremony for the first Medal: “It is impossible to live reasonably without science or beautifully without arts and letters.”

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Laudatio Jean-Philippe Dunand

Alexander De Becker

Jean-Philippe Dunand is one the most well known experts in the history of Labour Law. It is a much neglected branch of labour law though. Jean-Philippe Dunand is perfectly suited to receive the Sarton medal. He was born out of a Swiss father and a Roman mother. Who would suit better to teach about the history of the branch of law where balances play such an important role. He combines the Roman rich tradition with the Swiss neutrality. That perfectly fits with this topic.

Jean-Philippe Dunand was born 1966 in Geneva read Law at the University of Geneva. He obtained his Master at Laws in 1988. In 1991 he was admitted to the bar in Geneva. After a short period as barrister he returned to the University in 1994 and got his PH.D. (Dr.Juris) in 1999 in Geneva. His thesis, "Le transfert fiducaire: "donner pour reprendre". Mancipio dare ut remancipetur. Analyse historique et comparatiste de la fiducie-gestion" obtained the Bellot prize 1999 and the Walter Hug prize 1998/1999. During his doctoral study he received the Arditi Prize and Gide Prize in 1997 for his paper during his specialisation studies in Law.

In 2000 he was appointed as "professor extra-ordinarius" at the university of Neuchâtel. From 2001 to 2005 he was visiting professor and later senior lecturer at the University of Lausanne. In 2006 he became full professor at the University of Neuchâtel in charge of Roman law, Legal History and Labour Law. He also served as vice dean (2007-2009) and dean(2008-2011) of the faculty of Law. He was promotor of numerous projects and of five new PH.D's mainly about Labour Law and History of law.

He is a well known teacher at the university and received the Credit Suisse award for best teaching at the University of Neuchâtel in 2022.

The Swiss government appointed him to numerous advisory councils. He was chairman of the “Conseil de l’institut de droit de la Santé” (2013-2019), member of the “Commission fédérale pour les questions féminines”(2014-2019). In 2021 he lectured about European Social Law at the University of Paris-East.

He is not only the author of numerous legal books in his native French but also published a few years ago an international book about Labour Law in Switzerland together with Alexander Berenstein and Pascal Mahon already in the third print by Kluwer. His publication track record can only be quoted as exceptional. He manages to write a book a year. Speed does not always include profoundness. However, Dunand shows to be the exception to the rule. All of his books (on legal history, on labour law and on the history of labour law) are all considered to be groundbreaking. It shows the unbelievable track record of Jean-Philippe Dunand.

We are glad he accepted the Sarton medal for the faculty of Law 2022-23.

From Stichus the Slave to the Uber Driver

Six Forms of Subordination in the Employment Relationship

Jean-Philippe Dunand[1*]

1. Introduction

The meaning and content of the word "work" (in the sense of labour) vary greatly according to culture, place and time[2]. While its etymology remains uncertain[3], its various meanings (physical suffering, drudgery, toil, the effort required to do something, an activity that is tiring, an activity that requires overcoming resistance) seem to converge towards "an inextricable mixture of pain and creation"[4].

In an employment relationship, the worker performs a service for the benefit of another (natural or legal) person, enabling him or her to obtain his or her main means of subsistence, in a relationship of legal and economic subordination. Labour relations law should not be confused with (modern) labour law, which, as we shall see, was born in the 19th century as a reaction to the excesses of capitalism and as a consequence of the actions and demands of the workers' movement[5].

[1*] The author would like to thank Loïc Chollet, PhD in history, scientific collaborator at the University of Neuchâtel, Adrien Nastasi, BLaw, student-assistant at the University of Neuchâtel and Olivier Riske, PhD in law, lecturer at the University of Neuchâtel, for their help in researching sources, as well as in proofreading and translating this contribution into English.

[2] Mercury/Spurk, p. 1; Supiot, Critique, pp. 3-8.

[3] See Witzig, Droit du travail, pp. 13-15.

[4] Méda, p. 4.

[5] Dubler, Droit du travail, p. 3; Witzig, Droit du travail, p. 17.

The aim of this contribution is to provide a historical overview of the evolution of labour relations from Roman antiquity to the present day. More specifically, we have identified six typical workers whose activity was part of an epoch-specific labour relationship: the female or male slave (such as the slave Stichus) of Roman antiquity (**Chapter II**), the female or male serf of the Middle Ages (**Chapter III**), the female or male companion craftsman (journeywoman or journeyman) of the modern period (**Chapter IV**), the female or male factory worker at the time of the second industrial revolution (**Chapter V**), the female or male office worker of the 2000s (**Chapter VI**), as well as the female or male service provider of a digital platform (such as the Uber driver) in our 4.0 economy (**Chapter VII**). Labour relations may be analysed from a variety of perspectives: anthropological, economic, historical[6], legal, philosophical, psychological (including work psychology), scientific, sociological, theological, and so on. In this contribution, we shall limit ourselves to a few considerations relating to the history of law, and distinguish between the historical context and the legal regime in each chapter. We shall focus on the modalities of the relationship of subordination or dependence. When dealing with national legal systems, we shall focus on Swiss law and, to a lesser extent, French law.

2. The female or male slave

2.1. Historical context

In essence, in the ancient world, labour was despised[7]. In Greece, in the absence of a true market economy, each form of work retained its specificity[8]. Thus, attention was paid to the various occupations or tasks, without reducing them to a unified notion of work. In the scale of values, anyone who performed an activity in a state of dependence on another person was undervalued[9]. Such was the case of slaves, but also of craftsmen, who were compared to beggars, because they lived like the former, that is to say on the payment of others[10]. According to Aristotle, since freedom was linked

6 Our eminent colleague Professor George Sarton has shown the importance of the history of science in his masterly and impressive encyclopaedic work cited in our bibliography.
7 Flichy, p. 24.
8 Flichy, p. 24; Migeotte, pp. 10-12.
9 Méda, p. 10.
10 Méda, p. 10; Migeotte, pp. 12-13.

to the free disposal of one's time, work for others was to be considered a form of servitude, with the craftsman playing the role of a slave to the community[11]. Moreover, in this ancient conception, craftsmen had no skills of their own; they were merely imitating nature, implementing a collective know-how in order to make an object suitable for its use[12]. Thus, according to Plato, the carpenter who made a bed merely copied the shape of the bed that existed from all eternity[13]. Finally, only those citizens who were able to devote themselves to freely carried out activities, without any legal or economic dependence on others (e.g. philosophers or politicians) were respectable[14].

The Roman world adopted the Greek concept of work. Thus, Cicero wrote that anyone who offered his or her labour force for money was selling himself or herself and placing himself or herself among slaves: "*On the subject now of trades and earnings, on the question of which are to be considered worthy of a free man and which are to be considered vile, this is the generally received opinion [...]. Unworthy of a free man and vile are moreover the earnings of all wage-earners, for whom it is their labour and not their skill that is paid for: for in such earnings indeed the wage itself is the pledge of servitude. [...]. All craftsmen are engaged in a vile trade [...]. On the other hand, for those trades that require more prudence or from which an important service is expected, such as medicine, architecture or the teaching of noble knowledge, these trades – for those to whom they are suited – are beautiful trades*"[15].

Therefore, it was unworthy of a free man or woman to provide his or her services for a wage. If they had the opportunity, the Romans preferred to offer their services either under a contract of hire to complete a work (*locatio operis*, the forerunner of the works contract or, in the case of services based on a special bond of trust, under a contract of mandate (*mandatum*)[16]. That way, they did not work on behalf of others, as their services related to the fruits of their labour rather than to the work as such[17]. Moreover, Roman society was organised around the family, within which a large part of the labour relations was organised, under the authority of the *pater familias*,

11 Lévy, pp. 41-42.
12 Flichy, pp. 24-25; Méda, p. 10.
13 Plato, pp. 1205-1207.
14 Méda, p. 10.
15 Cicero, I.XLII.150-151, pp. 183-184.
16 Dunand/Schmidlin/Winiger, p. 105.
17 Supiot, Droit du travail, p. 8.

in the absence of any contractual framework[18]. A large part of the manual work and even certain intellectual services were carried out by slaves, who were considered to be property, and to whom no personal capacity to act was recognised[19]. Finally, in a society in which paid dependent work was hardly appreciated, only poorly trained citizens of modest origin and condition agreed to enter into a contract of hire of services (*locatio operarum*, the forerunner of the employment contract)[20]. By analogy with slavery, such persons rented themselves out, just as slaves could be rented out by their masters to a co-contractor under a contract for the rental of things (*locatio rei*, the forerunner of the lease contract)[21]. Employed on large agricultural estates, such workers (*mercenari*) were often entrusted with arduous and dangerous work[22].

In reality, in Roman society, as in Greek society[23], most of the work was done by slaves, mainly of foreign origin[24]. Most families owned slaves, two or three for the less fortunate, several hundred, even thousands, for the wealthiest[25]. Slavery was generalised and practised without major questioning. At most, there were some timid reservations on the part of the Stoics and Christians. The former postulated recognition of freedom for every human being and refuted any idea of slavery in accordance with nature[26]. However, they did not go so far as to formulate concrete proposals for its abolition[27]. Every master had a responsibility to behave with dignity towards his or her slaves. In one of his letters to Lucilius, governor of Sicily, the philosopher Seneca explained that slaves should be treated humanely: "*Be with your inferior as you would have your superior be with you [...] Show your slave kindness: admit him into your company, to your conversation, to your advice, to your table*"[28]. As for the Christians, while they asserted equal dignity of all human beings[29], they nevertheless refrained from questioning the established order[30].

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18 Dunand/Schmidlin/Winiger, p. 105. See also Dewerpe, p. 40.
19 Dunand/Schmidlin/Winiger, p. 105.
20 Dunand/Schmidlin/Winiger, p. 106.
21 Supiot, Droit du travail, pp. 8-9.
22 Schmidlin, p. 147.
23 Delacampagne, pp. 49-51.
24 Gaudemet/Chevreau, p. 331.
25 Delacampagne, p. 76; Gaudemet/Chevreau, p. 331.
26 Delacampagne, p. 89.
27 Schmidlin, pp. 142-144.
28 Seneca, p. 104.
29 Gaudemet/Chevreau, p. 450.
30 Delacampagne, p. 106.

The principle of natural freedom of every human being did not fail to exert a certain influence on the classical jurists, several of whom were followers of Stoic thought[31]. Thus, in his famous *Institutes*[32], the jurisconsult Gaius dealt with slavery and slaves in Book I, devoted to persons (see § 52-54), and not in Book II, dealing with the regime of property. From this point of view, the slave was seen as a virtual person, without legal personality, but capable of becoming a free person with full legal capacity upon eventual emancipation[33]. Moreover, the jurist Florentinus specified that servitude was an institution of the law of nations (*ius gentium*) by which one was subjected to the property of another, against nature (*contra naturam*)[34]. Similarly, Ulpian argued that while slaves did not count under civil law, this was not the case under natural law, for which all human beings were equal[35]. Finally, it was accepted that the child of a slave woman could not be considered as the fruit of a fruit-bearing thing, because it would have been absurd to equate a human being with a fruit, whereas nature, on the contrary, produced fruits only for the use of humans[36]. Under the Empire, with the spread of Stoic and Christian ideas, there was a gradual improvement in the lot of slaves (gradual abolition of the right to life and death, or acts of cruelty towards slaves, for example)[37], as well as a simplification of emancipation procedures[38].

2.2. Legal regime

In the first book of his *Institutions*, dealing with persons, Gaius set out the famous *summa divisio* according to which human beings were either free or slaves[39]. The main source of slavery was military conquests[40], especially in the last centuries of the Republic and the first century of the Empire[41]. The defeated were at the mercy of the victors. Instead of killing them, the latter could decide to let them live and reduce them to slavery (*conservare*,

31 Gaudemet/Chevreau, p. 333.
32 Gaius, 1.52-54.
33 Aubert, Esclavage, p. 20.
34 Florentinus, D. 1.5.4.1.
35 Ulpian, D. 50.17.32.
36 Justinian, Institutes, 2.1.37; Ulpian, D. 7.1.68.
37 See Gaius, 1.53.
38 Delacampagne, pp. 86-94; Gaudemet/Chevreau, pp. 333-334 and 450-451.
39 Gaius, 1.9.
40 Schmidlin, p. 144.
41 Gaudemet/Chevreau, p. 332.

servare). Regarded as having lost all legal status, the prisoners became slaves of those who captured them. They were then sold to merchants who sold them to Roman citizens. An estimated one million slaves were generated during Julius Caesar's campaigns alone[42]. The second important source of slavery was birth: a child born to a slave mother was a slave[43]. The child belonged to the mother's owner not because it was considered a fruit, but by virtue of a right of accession in accordance with the law of nations (*ius gentium*). Finally, Roman citizens could themselves be reduced to slavery (maximum reduction of personality, *capitis deminutio maxima*), particularly in case of desertion or insolvency[44].

A slave (*servus*) was not regarded as a subject, but as an object of law, a thing (*res*) that was owned by its master (*dominus*)[45]. Slaves were categorised as *res mancipi*, i.e., the essential belongings in a rural society, just like buildings or beasts of burden, and as such, were governed by specific rules. Like any other thing, a slave could be transferred (by sale, donation, testament or bequest), rented, lent, pawned or granted in usufruct[46]. If he or she was stolen or fled, the master could claim him or her (as property), or have him or her arrested so that he or she could be returned to him (*droit de suite*)[47]. Slaves were absolutely and unilaterally subject to their master's power (paternal power, *patria potestas*)[48]. Slaves had no legal protection, and their masters could, for example, strike or even kill them (power of life and death)[49]. A slave had to accomplish all required work, with no maximum working time or right to rest. His or her master was free to use his or her labour power until he or she was exhausted. In his treatise on agriculture dating from 160 BC, the politician and writer Cato the Elder expressed this concept quite well, seeing slaves as nothing more than a piece of property to be disposed of when they became less profitable, for example due to illness or old age[50].

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42 Delacampagne, p. 73.
43 Schmidlin, p. 144.
44 Schmidlin, p. 145.
45 Aubert, Esclavage, p. 19.
46 Aubert, Esclavage, p. 20.
47 Book 11, title 4 of Justinian's Digest is devoted to fugitive slaves.
48 Schmidlin, p. 151.
49 Gaius, 1.52.
50 Cato the Elder, Rural Economy, Duty of the Head of Household, p. 2.

A slave had a first name but no surname. He or she had no personal or property rights[51]. He or she had no property of his or her own, could not marry nor start a family, could not acquire nor pass on property by virtue of death, and had no access to courts of law[52]. As a slave had no civil status nor personal capacity, his or her acts had no direct legal effect and were only relevant as natural facts[53]. However, some masters used their slaves in their commercial relations by giving them a kind of fictitious or virtual legal personality[54]. These masters then endowed them with a *peculium*, in the form of a capital sum or a small business, which allowed them to enter into contracts and develop commercial activities, under their control and with their authorisation[55]. Legally, the *peculium* belonged to the master since the slave had no property of his or her own; socially, however, it was deemed to belong to the slave[56].

In principle, a slave retained his or her status throughout his or her life, unless his or her master decided to set him or her free by using one of the forms prescribed in the Roman legal order[57]. Often, the slave "bought back" his or her freedom, with the capital he or she had built up[58]. Through emancipation (*manumissio*), the slave was granted freedom and, albeit with some restrictions, Roman citizenship and personal capacity[59]. The freed slave remained bound to his or her former master, whose name he or she bore, and to whom he or she owed respect and obedience (*obsequium*). He or she was also obligated to render him or her certain services (*operae*), in particular in the form of working days. Sometimes, the former master imposed on the freed slave a clause prohibiting competition at the time of his emancipation[60]. Lastly, the former master had a right of inheritance over the freed slave's estate if the latter had no heirs (*bona*).

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51 Gaudemet/Chevreau, p. 333.
52 Delacampagne, p. 74; Gaudemet/Chevreau, p. 333.
53 Schmidlin, p. 148.
54 Aubert, Esclavage, p. 22.
55 Schmidlin, p. 149.
56 Pichonnaz, pp. 129-130.
57 Gaudemet/Chevreau, pp. 336-339.
58 Delacampagne, p. 79.
59 On the consequences of enfranchisement, see Gaudemet/Chevreau, pp. 339-341; Pichonnaz, pp. 130-132; Schmidlin, p. 150.
60 See Alfenus Varus, D.38.1.26.

3. The female or male serf

3.1. Historical background

The decline and eventual end of the Western Roman Empire in 476 saw the downturn of widespread slavery and its gradual replacement by serfdom during the Middle Ages. The decline of slavery as a dominant mode of production and labour may be explained by the end of Roman military and territorial expansion after Trajan's reign, which had been the main source of supply of slave labour, by the massive increase in the practice of emancipation, by the refusal to subject Christians to slavery, and by the subsequent increase in the sale price of slaves[61]. However, these developments did not lead to the total abolition of slavery, which persisted on European soil until the end of the 16th century[62], when it developed in the American colonies administered by European countries[63]. It was officially abolished only in 1807 by Great Britain, in 1848 by France and in 1865 by the United States.

The disintegration of the Roman Empire, coupled with invasions by Germanic peoples and periods of plague, led to a general disruption of the economy, high levels of insecurity and the ruralisation of the population[64]. The wealthy landlords withdrew to their landholdings and recruited large numbers of farm workers, often couples, who sought to feed and protect themselves. In order to ensure a constant income and to stop a trend towards geographical mobility, the landlords imposed a personal dependency on the peasants, as well as the obligation to remain attached to the glebe (land) on which they worked[65]. Peasants were thus "chased" (provided with a house, *casa*)[66]. Among these peasants, some were considered free, and called "vilains" (from *villa*, large estate), and the others were serfs (*servi*)[67]. These practices may be regarded as the first origin of serfdom[68]. The latter may also be understood in connection with the development of feudalism, which reached its peak between the 11th and

61 Delacampagne, p. 97; Fossier, p. 31.
62 Carrier, Esclavage, pp. 179-196; Delacampagne, pp. 96 and 105-124.
63 Delacampagne, pp. 127-173; Dewerpe, pp. 54-57.
64 Delacampagne, pp. 98-99.
65 Delacampagne, p. 98.
66 Fossier, p. 32.
67 Alba, Moyen Age, p. 146.
68 Delacampagne, p. 98.

13th centuries[69]. Following the gradual dismemberment of the Carolingian Empire, Western Europe was divided into a multitude of small autonomous seigneuries. Over time, a hierarchy of nobles was established: simple knights without vassals, barons, viscounts, counts, dukes and king[70]. To this hierarchy of men, formalised by the vassalic contract linking suzerains to their vassals, a hierarchy of lands was added, which was made possible by the dismemberment of the property right over the fief. As the nobles and ecclesiastical lords were occupied with military or religious affairs, and as they considered it undignified for them to personally look after the land, they assigned the peasant serfs the task of cultivating it. Between the 7th and 11th centuries, serfdom gradually replaced slavery and became widespread in Europe.

In a predominantly rural economy, most peasants were serfs[71]. The Church, as a large owner of land cultivated by serfs, did not object to this[72]. It is worth noting that the Church recognised serfdom as a human institution, as a consequence and punishment of original sin[73]. Thus, in his *Praeloquia*, Rathier of Verona (appointed bishop of Verona in 931) considered that work seemed to be better suited to servitude than to freedom[74]. Almost a century later, in his famous *Poem to King Robert* (*Carmen ad Robertum*), Bishop Adalberon distinguished, in order to describe the organisation of earthly society, three orders or "states", corresponding to three functions: "*Nunc orant, alii pugnant aliique laborant*"[75]. A distinction had thus to be made between those who prayed (*oratores*), i.e. the clergy, those who fought (*bellatores*), i.e. the nobles, and those who worked (*laboratores),* i.e. all those who were neither clergy nor nobles. In Adalberon's mind, also, all workers were to be considered serfs: "*Who could reconstruct, by counting on the signs of the abacus*[76]*, the effort of the serfs, the course of their lives and their innumerable labours? To provide all with wealth and clothing: this is the serf's pasture. For no free man can live without serfs. When a task presents itself and they wish to bear the expense, the king as well as the bishops seem to put themselves under the dependence of their*

69 Delacampagne, pp. 99-100.
70 Alba, Moyen Age, p. 142.
71 Delacampagne, p. 105.
72 Dubler, Servage, p. 2.
73 Dubler, Servage, p. 2.
74 See Carrier, Travail, pp. 20-21.
75 Adalberon of Laon, N 295, pp. 22-23.
76 The abacus was a calculation tool.

serfs. The lord is fed by the serf he presumes to feed. There is no end to the complaint and tears of the serfs"[77]. Also, Thomas Aquinas wrote in the 13th century that it was in the order of things that some men were born to be the servants of others for the rest of their lives[78].

Serfdom declined from the 14th and 15th centuries onwards in the medieval West, following the evolution of Christian thought, peasant revolts, the generalisation of the emancipation of serfs and waves of mortality (wars and epidemics)[79]. Due to a lack of manpower, estates were abandoned. With the increased use of money, serfs were able to negotiate a remuneration, the money they saved allowing them to buy their freedom[80]. The landlords were forced to make concessions (e.g. reduction of seigniorial rights) in order to keep the labour force they needed to cultivate their lands. As a result, the ties between the rural serf populations and their landlord were loosened[81]. The last quarter of the 18th century saw the end of serfdom. Under the influence of his minister Necker, the author of a "Report to the King on the Abolition of the Mainmorte"[82], King Louis XVI promulgated, on 8 August 1779, an edict aimed at abolishing the vestiges of medieval serfdom (notably the abolition of all personal servitude on the royal domain and the abolition of the *droit de suite*)[83]. Serfdom was formally abolished in France by the decree of the Constituent Assembly of 4-11 August 1789, abolishing "*all rights... which are related to the mainmorte... and to personal servitude*"[84]. In Switzerland, it was banned at the same time as feudal dues by an Act of 4 May 1798, passed under the Helvetic Republic (a political regime imposed by the French Directory): "*That all personal feudal rights are hereby abolished without compensation*"[85]. In Eastern Europe, east of the river Elbe, a second form of serfdom spread from the 16th century onwards[86]. It was only formally abolished in Russia in 1861[87].

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77 Adalberon of Laon, N 277, pp. 20-21. See Carozzi, pp. 683 ff; Carrier, Travail, pp. 24-31.
78 See Delacampagne, p. 107.
79 Delacampagne, pp. 104-105; Dewerpe, pp. 27-28.
80 Cartwright, Serf, p. 9.
81 Degen/Rippmann, p. 1.
82 Necker, pp. 486-491.
83 Edict of August 1779, abolishing the *droit de mainmorte* and servitude in the King's domains, and in all those held by commitment: and general abolition of the *droit de suite* on serfs and *mainmortables*, in: Œuvres complètes de M. Necker, published by M. le Baron de Staël, volume three, Paris 1820, pp. 491-496.
84 Decree published in: Décrets de l'Assemblée nationale des 4, 6, 7, 8 & 11 août 1789, Lyon 1789.
85 Law of 4 May 1798, Abolition of all personal feudal rights, in: Bulletin des loix et décrets du Corps législatif de la République helvétique, Lausanne 1798, p. 43. See Dubler, Servage, p. 8.
86 Dewerpe, pp. 57-59.
87 Carrier, Question, p. 107.

3.2. Legal regime

Serfdom was characterised by the existence of a personal and real bond of dependence: one person, the serf, had to serve another, the lord or master, because of the existence of a seigneury and the allocation of an allotment of land. The medieval serf worked on the lord's land in exchange for physical and legal protection and the right to use a separate plot of land for his or her own needs[88]. He or she was tied to a plot of land which he or she cultivated and was forbidden to leave[89]. The Latin term "*servus*" may have referred to both the slave and the serf[90]. However, the medieval serf did not have the same legal status as the Roman slave, since he or she was deemed a human being, a person, and not a thing. Moreover, the lord's power over the serf was the result of customary rules applicable in a given place and was therefore not unlimited as was the master's power over his or her slave[91].

The legal status of the serf was of a mixed nature, based on the recognition of a certain legal personality, combined with strong restrictions on his or her freedom. The serf enjoyed relative economic independence. He or she was the holder of his or her own patrimony which he or she could manage, at least in appearance, quite freely. He or she was allowed to use part of his or her time to cultivate land for his or her own benefit[92]. In addition, he or she was recognised as having the right to family life. But this right also served the economic interests of the lord, since he or she was relieved of the maintenance of his or her serfs' family and benefited from the growth of said family, since the status of serf was hereditary[93].

Despite this status of a free person, the serf lived in close dependency to his master, the landowner, who could sell him or her (or at least his or her labour force), exchange him or her, bequeath him or her, pawn him or her or rent him or her out as he saw fit[94]. He or she represented an element of the lord's fortune through his or her labour force and the taxes he or she had to pay[95]. According to the established formula, he or she was "*taillable*

88 Cartwright, Serf, p. 1.
89 Delacampagne, p. 100.
90 Carrier, Question, pp. 107-108.
91 Carrier, Question, p. 110; Delacampagne, p. 103.
92 Cartwright, Serf, p. 3; Delacampagne, p. 102; Dewerpe, p. 24.
93 Delacampagne, pp. 102-103.
94 Carrier, Question, pp. 108-109; Delacampagne, p. 102; Dubler, Servage, p. 3.
95 Bart, pp. 149-150; Dubler, Servage, pp. 2-3.

et corvéable à merci", i.e., in the measure of the lord's mercy[96]. In particular, he or she had to pay the "*taille*", a direct tax, which was sometimes arbitrarily fixed, on the profits from his or her work or trade. He or she was also obliged to perform "*corvées*", i.e. free days of work for his or her lord. In principle, the serf worked for his or her master only part of the week (sometimes the whole week, as in harvest time). Men usually worked in the fields (mowing, harvesting) and women made butter and cheese, brewed beer or tended orchards[97]. The serf also had to pay the annual chevage or capitation tax, a relatively small amount, but it was a token of the servitude and therefore had a vexatious aspect[98].

Other legal aspects expressed the strong bonds of dependence of the serf[99]: he or she was attached to the territory of the seigneury in perpetuity; when the land was sold by his or her lord, he or she became dependent on the new owner; if he or she ran away, which was quite frequent given the contempt and humiliation he or she was subjected to, the lord could pursue him or her and bring him or her back by force (right of pursuit)[100]; he or she could not freely dispose of his or her property: he or she was said to be "*mainmortable*" (from "*main*", power over property and "*morte*", without effect); he or she had no testamentary capacity, and in the event of his or her death, his or her lord inherited his or her property; he or she was subject to the exclusive jurisdiction of his or her lord; lastly, he or she could only marry with the authorisation of his or master (*licencia maritandi*) and if, as a result of the marriage, he or she left his or her original seigneury, he or she had to pay a "*formariage*" tax (*foris maritagium*, marriage outside his or her seigneury). The serf was the object of contempt and mockery, excluded from the people and ignored by the institutions. He or she could not, for example, pursue a military career or testify against a free person, and he or she was forbidden to enter a church through the main door[101]. As already mentioned, the legal regime of serfdom was relaxed over the centuries (e.g., the right of mortmain was limited to the transfer of the best animal or the prohibition of *formariage* was transformed into a royalty redeemable in money)[102].

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96 Alba, Moyen Age, p. 147; Carrier, Question, pp. 121-123.
97 Cartwright, Serf, pp. 5-6.
98 Bart, p. 149.
99 Bart, pp.150-155; Castaldo, N 605-613; Dubler, Servage, p.3; Necker, pp.486-491.
100 This right of action is similar to the right of the master over his slave in Roman law. One author has made the connection with Art. 337d of the Swiss Code of Obligations (CO) on the abandonment of employment (cf. Gloor, p. 199).
101 Delacampagne, p. 102.
102 Dubler, Servage, p. 4.

Like slavery, serfdom was hereditary. Thus, a child born to a father and mother who were themselves serfs had the status of a serf[103]. In the case of mixed marriages, different rules could apply depending on the time and place: the mother's condition ("the child follows the womb"), the father's condition, the principle of freedom (according to a decree of Pope Urban III in 1187) or the principle of serfdom ("the worst takes along the better", according to a Frankish custom). One could also acquire the status of a serf by marriage, in particular when a free woman married a serf, by an act of voluntary submission, when one commended oneself to a lord, or when one took up residence in a village where the presumption of unfreedom prevailed, which made one a serf after one year and one day[104]. In principle, one retained the status of a serf for life. However, certain procedures or actions allowed access to freedom. The lord could grant freedom to his or her serfs through individual or collective emancipations, usually against the payment of a sum of money ("redemption" of freedom)[105]. However, those granted freedom were still obliged to pay regular fees and taxes to the lord[106]. Freedom could also be obtained by the purchase of a franchise, by a right of asylum in churches and monasteries, or by settling in a town ("the air of the town sets free"), which could give the serf immediate freedom or after a period of one year and one day[107].

4. The journeywoman or journeyman

4.1. Historical context

In the 12th-13th centuries, Europe experienced a strong development of trade which contributed to the rebirth of its cities[108]. Many peasants were attracted by the new work opportunities. They settled in the suburbs of the cities, whose inhabitants were called "bourgeois"[109](citizens or burgers). The population of the towns, including craftsmen and merchants, obtained franchises from

103 Bart, p. 146.
104 Bart, p. 148; Castaldo, N 603.
105 Dubler, Servage, p. 4.
106 Bart, pp. 156-158.
107 Castaldo, N 616.
108 Alba, Moyen Age, pp. 152-153.
109 Alba, Moyen Age, p. 153.

the lords to whom they were submitted[110]. This could include, for example, the recognition of personal freedom, jurisdictional privileges or the waiver of certain taxes[111]. It is probably from the desire of merchants and craftsmen to group together to defend themselves against the seigneurial authority that the guilds were born[112], also called, depending on the place and the time, communities of arts and crafts, confraternities, corporations, hanses, etc.[113]. The latter had a decisive influence on the urban organisation[114].

Almost all professions were organised into guilds (lawyers, public prosecutors, notaries, doctors, royal secretaries, trades in arts and crafts, industry and commerce)[115]. In France, the royal power was quick to recognise and control them. As early as the 13th century, King Louis IX (Saint Louis) had the Provost of Paris draw up a *Book of Trades* which codified the statutes of the Parisian guilds[116]. The guilds fulfilled many functions[117]. In particular, they regulated production standards (weight, dimensions, materials, etc.), certifications of origin and conformity, product prices, working conditions and wage levels. Thus, in the 13th[e] century, the statutes of the Paris shoemakers' guild prohibited the use of low-quality leather under penalty of destruction of the counterfeit goods[118]! It was also a question of fighting against any form of internal or external competition (non-affiliated foreigners, craftsmen from the countryside) and of constituting an often-feared political weight in the face of the authorities. The corporatist system thus guaranteed consumers quality products and moderate prices, and a limited free competition for master craftsmen[119]. In principle, craftsmen were not attracted by the ideal of maximising profits, but rather by the ideal of honesty, fair profit and confraternity[120]. Guilds were also active as religious fraternities with many activities including attending the funerals of their members and providing aid to orphans and the sick[121]. Each guild chose a saint as its patron (St. Crepin for shoemakers, St. Joseph for car-

110 Simon-Muscheid, p. 1.
111 Alba, Moyen Age, p. 153.
112 The term "corporation" was used from the 18th century onwards (cf. Dewerpe, p. 65).
113 Simon-Muscheid, p. 1; Timbal/Castaldo, p. 470.
114 Timbal/Castaldo, p. 470.
115 Timbal/Castaldo, p. 469.
116 See Boileau, Le Livre des métiers.
117 Alba, Moyen Age, p. 204; Dewerpe, pp. 65-67; Simon-Muscheid, p. 2.
118 Boileau, pp. 183-184.
119 Timbal/Castaldo, p. 471.
120 Dewerpe, pp. 64-67.
121 Dewerpe, p. 67.

penters, St. Peter for bakers, etc.)[122]. Great feasts were organised in his or her honour by the guild's own fraternity[123].

The guilds of craftsmen, which were particularly characteristic and numerous, included all the craftsmen who practised the same trade in the same town: gunsmiths, butchers, bakers, clothmakers, blacksmiths, dyers, goldsmiths, saddlers, tailors, tanners, weavers, etc.[124]. One's situation was publicly displayed by a particular outfit (hat, coat, sword) and insignia (tool symbolising the profession)[125]. Trades were precisely defined in the statutes in order to prevent any spillover into the activities of neighbouring trades (for example, a locksmith does not practice the same trade as a blacksmith)[126]. Depending on the needs of society and the evolution of techniques, new trades appeared, such as harquebus or cannon makers (15th century), paper makers (16th century) or button makers and watchmakers (17th century)[127].

In principle, a craftsman made an object by hand from start to finish, without a precise division of tasks[128]. He was recognised as having real know-how, based on his practical sense and his knowledge of the rules of the trade[129]. A craftsman was considered to be a "professional" who performed a task (but did not work), unlike "handymen" who rented out their labour power for simple handling work[130]. The evolution of the social status of the craftsman was notably due to changes in the perception of work that took place during the Middle Ages in theological discourse[131]. In the first part of the Middle Ages, work was still regarded with suspicion and contempt[132]. According to the Judeo-Christian conception, it was considered a curse and a punishment for sin[133]. Work had no value in itself, but had to be done for the sake of one's fellow man and the community, according to God's will[134]. It was a form of obedience to the Creator that elevated the worker towards God[135].

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122 Alba, Moyen Age, p. 206.
123 Timbal/Castaldo, p. 470.
124 Cartwright, Métiers, pp. 1-7.
125 Dubler, Profession, p. 2.
126 Dewerpe, p. 66; Timbal/Castaldo, pp. 470-471.
127 Dubler, Artisanat, p. 6.
128 Dewerpe, pp. 63-64.
129 Dewerpe, p. 64.
130 Dewerpe, pp. 64 and 67; Supiot, Droit du travail, p. 10.
131 Rippmann, pp. 1-3.
132 Dewerpe, pp. 44-45.
133 Da Silva, pp. 97-98.
134 Rippmann, p. 2.
135 Fossier, p. 21.

From the 13th century onwards the thinking of theologians evolved in the context of the activities of monks in monasteries and the forms of work carried out in the cities. In Cistercian and Franciscan monasteries, monks practised contemplation and manual work, activities that were no longer considered incompatible[136]. According to the Liturgy of the Hours of St. Benedict, for example, the time for divine reading had to be organised and consequently so did the time for manual work[137]. Furthermore, the system of managing their huge agricultural estates led monks to recruit agricultural workers[138]. Religious and lay people alike were considered to be under the obligation to work in order to support themselves and to preserve their souls[139]. According to the Franciscan preacher Berthold of Regensburg, for example, the work of honest people was considered useful and indispensable[140]. In the same sense, and at the same period, Thomas Aquinas developed the idea of common utility making certain tasks and trades, and their remuneration, permissible[141]. Thus, the wage received by a craftsman could be considered as compensation for the service rendered to the common good and the profit of the merchant as the price of his or her economic risk[142]. In the late Middle Ages, the words "profession" and "trade" were used in the sense of a regular activity dependent on training and qualification. Over time, a distinction was made between a trade, which was the activity of a craftsman who had completed an apprenticeship, and a profession, which was an intellectual or artistic activity that enjoyed a certain prestige and was accessed through studies[143].

Already in the 13thᵉ century and up to the beginning of the modern era, small craftsmen were the main force of the urban economy in Europe[144]. The industrial fabric was made up of small workshops[145]. Often craftsmen were located in the same street for a same trade[146]. They also relied on rural workforce, to whom they entrusted raw materials to have semi-finished products made at home. Home workers, like craftsmen, organised their

136 Rippmann, p. 2.
137 See Musso, p. 11.
138 Fossier, p. 22.
139 Rippmann, p. 3.
140 Berthold of Regensburg, Les dix chœurs, pp. 26-37.
141 See Méda, p. 14.
142 Dewerpe, p. 47; Fossier, pp. 22-23.
143 Dubler, Profession, p. 2.
144 Dubler, Artisanat, p. 3.
145 Aubin/Bouveresse, N 18; Dubler, Artisanat, p. 1.
146 Fossier, p. 105.

working day in their homes or workshops[147]. From the 17th century onwards, manufactories appeared which permitted a large number of craftsmen to be grouped together under the direction of the same entrepreneur, either in the same place or in several small joined workshops[148]. A manufactory was a closed world subject to a restrictive discipline (observance of punctuality, strict silence, prohibited displacements, etc.)[149]. In Switzerland, manufactories developed mainly in the textile industry and, to a lesser extent, in watchmaking and ceramics[150]. From the end of the 17th century onwards, printing of "*indiennes*" (cotton fabrics) became the main manufacturing activity in Switzerland[151]. In France, under the impulse of Colbert, Louis XIV organised state manufactories with privileges and monopolies, which produced important economic products such as sheets, mirrors, porcelain objects, tapestries, steel or lace[152]. Manufactories were not yet very mechanised[153]. But new forms of work organisation were introduced, including a certain hierarchy and a breakdown into specialised tasks, either by trade or by operation[154]. Moreover, in the 18th century, in his work on the nature and causes of the wealth of nations, the Scottish economist and philosopher Adam Smith theorised the supposed advantages of parcelling out of tasks (saving time, increasing skills of each worker, stimulating inventiveness and development of machines, etc.)[155]: "*The greatest improvements in the productive power of labour, and the greatest part of skilfulness, adroitness, and intelligence with which it is directed or applied, are due, it seems, to the Division of labour... in every art, the division of labour, as far as it can be extended, brings a proportionate increase in the productive power of labour. It is this advantage which seems to have given rise to the partition of the various jobs and trades*"[156].

147 Degen/Rippmann, p. 2.
148 Alba, Age classique, p. 437; Dewerpe, pp. 67-68.
149 Aubin/Bouveresse, N 26; Dewerpe, p. 69.
150 Pfister, p. 1; Rappard, pp. 53-76.
151 Pfister, p. 2.
152 Alba, Age classique, pp. 437-438; Dewerpe, pp. 68-69.
153 Pfister, p. 1.
154 Aubin/Bouveresse, N 135; Degen/Rippmann, p. 3; Dewerpe, pp. 67-68.
155 Mercury, p. 108.
156 Smith, pp. 7 and 10.

4.2. Legal regime

The communities of trades (guilds) enjoyed in principle a monopoly and a certain autonomy to define the rules governing a given profession (closed professional grouping)[157]. However, they were subject to authorisation and a certain amount of control by the lord or town on which they depended[158]. In France, the statutes of guilds as well as the creation of new trades had to be approved by royal authority[159]. Only members of the corporation could carry out the concerned activity and recruit employees[160]. At the same time, anyone wishing to practice a trade had first to be admitted to the guild[161]. The corporatist system thus prevented the emergence of a free labour market[162]. Guilds were managed by a small group of masters who appointed jurors to settle disputes between members as well as labour disputes (guild jurisdiction)[163]. Guilds were dominated by men. In fact, most guilds were closed to women[164]. However, women were allowed to access certain trades (e.g. lace, silk or veil production), but they were rarely granted the status of mistress[165].

The internal organisation of a crafts enterprise was based on a strict hierarchy: apprentice, journeyman and master[166]. The apprentice was introduced to the practice of the trade during a training period lasting several years. He or she was provided with accommodation, food and clothing by the master craftsman, but in principle did not receive a salary[167]. He or she was often regarded as the domestic servant of his or her employer[168]. Discipline was harsh and the master craftsman had the right to punish him or her[169]. At the end of the apprenticeship, the apprentice could become a journeyman or journeywoman, i.e. a skilled worker working with a master, after having obtained a certificate of apprenticeship issued by the guild. The journey-

157 Aubin/Bouveresse, N 19; Dewerpe, p. 65.
158 Dewerpe, p. 65.
159 Timbal/Castaldo, p. 470.
160 Simon-Muscheid, p. 2.
161 Dubler, Artisanat, p. 3; Perrenoud, p. 178.
162 Dewerpe, p. 64.
163 Cartwright, Guildes, p. 2; Dubler, Droit du travail, p. 3.
164 Dubler, Artisanat, p. 9.
165 Cartwright, Guildes, p. 6; Dewerpe, pp. 14-15.
166 Aubin/Bouveresse, N 19.
167 Cartwright, Métiers, p. 2.
168 Alba, Moyen Age, p. 205.
169 Alba, Moyen Age, p. 205.

man or journeywoman was hired by the day, week or year[170]. He or, more rarely, she could become a master or mistress, i.e. a business manager running a retail shop or a workshop, at the end of a period of companionship during which he or she sometimes did a 'tour of France' in order to perfect his or her technical skills[171]. To obtain a master's degree, the journeyman or journeywoman had to pass a professional examination and complete a "masterpiece". He or she also had to offer a banquet to the masters, pay a fee to the guild and to the royal treasury (in France), and demonstrate that he or she could finance his or he own workshop[172].

The legal framework for the employment relationship between the master and his employees (apprentices and journeymen or journeywomen) was mainly laid down in the statutes of the relevant guild[173]. This was the case for the journeyman's or journeywomen's salary (in principle it was forbidden to provide for a lower or higher salary)[174], the duration of the apprenticeship or the dismissal procedure (as a rule only the master could terminate the contract)[175]. More specific clauses, for example on apprenticeship costs, holidays or board and lodging with the master craftsman, were included in the individual employment contracts[176]. The artisan's workshop was usually located in the same building as the master's flat. Thus, the workplace and the living quarters of the master's family were combined[177]. The couple and their children formed a working community[178]. This community extended to the apprentices, and sometimes even the journeymen or journeywomen, who lived in the master's house[179]. The working day extended from sunrise to sunset and was therefore longer or shorter depending on the season[180]. It was generally forbidden to work at night, partly because of the risk that the work would be poorly executed (bad light), and partly because the light sources (candles) could cause fires[181]. The aim was also to limit unfair practices between craftsmen due

170 Alba, Moyen Age, p. 205.
171 Timbal/Castaldo, p. 471.
172 Cartwright, Guildes, p. 4; Timbal/Castaldo, p. 471.
173 Witzig, Droit du travail, N 28.
174 Cartwright, Guildes, p. 4.
175 Dubler, Droit du travail, p. 3; Timbal/Castaldo, p. 471.
176 Dubler, Artisan, p. 6.
177 Dewerpe, p. 63; Mahon, p. 297.
178 Mahon, p. 297.
179 Alba, Moyen Age, p. 205; Aubin/Bouveresse, N 87; Le Goff, p. 50.
180 Alba, Moyen Age, p. 205.
181 Alba, Moyen Age, p. 204.

to excessive work rates[182]. Therefore, the prohibition of night work was not dictated by a concern for the protection of workers[183].

Over time, access to mastery became increasingly difficult and expensive for the simple journeyman or journeywoman[184]. The mere realisation of the masterpiece could be insurmountable (difficulty, duration of realisation, cost of materials)[185]. In fact, the status of journeyman became a permanent state, as each master succeeded the other from father to son or from father-in-law to son-in-law[186]. Trapped in this status, with no possibility of evolution, the journeyman or journeywoman was doomed to "eternal subordination"[187]. Journeymen or journeywomen grouped together in parallel, sometimes secret, associations or guilds, the "*Compagnonnages*", which were first intended to facilitate the "tour de France", and then used to defend their common interests towards their masters (foreshadowing the trade unions)[188].

5. The female or male factory worker

5.1. Historical context

The French Revolution (abolition of the corporative system) and the (first) Industrial Revolution (use of new forms of energy) contributed to the gradual decline of craftsmanship in favour of industry and the replacement of artisanal manufactories by increasingly mechanised factories or plants[189]. In the last quarter of the 18th century, economic theorists (called economic philosophers or physiocrats because they worshipped the earth and the rules of nature) argued for the end of the corporatist regime and the consecration of economic freedom[190]. The Comptroller General of Finances under Louis XVI, Baron Turgot, who was responsive to these new ideas, obtained from the king the promulgation of the edict of 1776 abolishing the

182 Fossier, p. 50.
183 Mahon, p. 298.
184 Simon-Muscheid, p. 5.
185 Dewerpe, p. 66.
186 Alba, Age classique, p. 447; Aubin/Bouveresse, N 20.
187 Aubin/Bouveresse, N 87.
188 Alba, Age classique, p. 447; Aubin/Bouvressse, N 32-34; Le Goff, pp. 128-129; Timbal/Castaldo, p. 472.
189 Dubler, Artisanat, pp. 14-16.
190 Timbal/Castaldo, p. 472; Witzig, Droit du travail, N 33.

corporations[191]. The abolition of corporatist organisations was supposed to promote access to employment (especially self-employment) for all who needed it[192]: "*We owe it to all our subjects to ensure the full & complete enjoyment of their rights; we owe this protection above all to this class of men, who, having no property other than their work & industry, have all the more the need & the right to employ to the fullest extent the only resources they have for subsistence*"[193]. The edict met with strong resistance and was suspended[194].

The prohibition of guilds was definitively entrenched in the early years of the French Revolution in a general movement of exaltation of the rights of the individual[195]. Thus, on 4 August 1789, the Constituent Assembly voted for the full and complete abrogation of feudal rights and of all the privileges of bodies and communities[196]. Then, from 2 to 17 March 1791, it approved the Act of 17 March 1791 on the suspension of all aid rights, all masteries, guilds, and establishments of patent rights, known as the Allarde Decree, because it resulted from the report of Baron Leroy D'Allarde[197]. According to art. 7 of said Act, "*any person shall be free to engage in such trade or to exercise such profession, art or trade as he sees fit; but he shall be required to obtain a patent beforehand, to pay the price thereof, and to comply with the police regulations which are or may be made*"[198]. This first Act was soon followed by a second one, prepared by the attorney-at-law from Rennes, Isaac Le Chapelier, which prohibited all forms of guilds or associations of citizens[199]: "*The annihilation of all sorts of guilds of citizens of the same state or profession being one of the fundamental bases of the French constitution, it is forbidden to re-establish them in fact, under any pretext and in any form whatsoever*" (art. 1 of the Le Chapelier Act of

191 Edict of the king abolishing the jurandes and communities of commerce, arts and crafts (February 1776), Paris 1776.
192 Méda, p. 44; Supiot, Droit du travail, pp. 13 and 65.
193 Edict of the king abolishing the jurandes and communities of commerce, arts and crafts (February 1776), Paris 1776, p. 1.
194 Olszac, p. 22; Timbal/Castaldo, pp. 472-473.
195 Timbal/Castaldo, p. 491.
196 Decree published in: Décrets de l'Assemblée nationale des 4, 6, 7, 8 & 11 août 1789, Lyon 1789.
197 Aubin/Bouveresse, N 102.
198 Text of the decree on patents, during the session of 2 March 1791, in: Archives parlementaires de 1787 à 1860, première série (1787-1799), tome XXIII, du 6 février au 9 mars 1791, Paris 1886, pp. 625-630.
199 Le Goff, pp. 124-126; Olszak, pp. 25-27.

14 June 1791)[200]. It was thus prohibited to create associations destined to defend the interests of workers (unions) or employers[201]. These developments reached Switzerland in October 1798 when the Helvetic Republic proclaimed freedom of trade and industry, thereby abolishing the corporatist system[202], and thus the requirement of belonging to a guild in order to exercise the concerned trade[203]. Similar rules were approved at the same time in all industrialising countries[204].

The French Revolution promoted the abstract labour contract against the corporative system; in order to freely exercise any form of commercial, artisanal or industrial activity, the employer had to be able to freely hire the workforce[205]. There were to be no more guilds in the state; only the particular interest of each individual and the general interest were to be considered[206]. The freedom to choose a trade according to one's aptitudes and aspirations replaced hereditary transmission[207]. The consecration of entrepreneurial freedom and freedom of work was the result of liberal thinking, which developed progressively starting with the physiocrats and extending to the capitalist economists of the 19th century[208]. It was also based on a reinterpretation of the biblical texts in the sense of a valorisation of earthly activities and the desire for enrichment[209]. At the end of the 18th century and the beginning of the 19th century, it was considered that labour should be associated with the idea of wealth and no longer with that of pain or fatigue. It became a vocation, a goal in itself[210]. Freed from its old ties, it guaranteed both the control of individual existence and collective progress[211].

Capitalism was built on several foundations: the importance given to private property, economic freedom, free competition and the limited role of the state[212]. Adam Smith, regarded as one of the forerunners of liberal

200 Decree relating to the assemblies of workmen and craftsmen of the same state and profession of June 14-17, 1791, in: Collection complète des lois, décrets, ordonnances, règlements et avis du Conseil-d'Etat, tome troisième, Paris 1824, pp. 25-26.
201 Aubin/Bouveresse, N 105-112.
202 Dubler, Artisanat, p. 11.
203 Simon-Muscheid, p. 7.
204 Olszak, p. 25.
205 Witzig, Droit du travail, N 36.
206 Aubin/Bouveresse, N 106; Olszak, p. 26.
207 Dubler, Profession, p. 4.
208 Aubin/Bouveresse, N 22; Halpérin, p. 107.
209 Méda, pp. 16-17.
210 Dewerpe, p. 72.
211 Rippmann, p. 7.
212 Alba/Isaac, p. 869.

thinking, evoked the prominent position of labour as a creative force, a source of wealth and a measure of the market value of everything[213]. Fully free in his own right, a worker could sell the use of his or her labour power, which had become a commodity, on a free labour market[214]. The price of this commodity was fixed by the interplay of supply and demand[215]. According to the principle of freedom of contract, the parties to the employment contract were free to define the conditions of employment and remuneration[216]. In practice, such a conception of freedom of labour did not account for the reality: the material inequality between the parties and the economic dependence of the worker on the employer. It led to the isolation of workers, who were forbidden to join together to defend their interests[217]. A fictitious equal partner of his employer, the worker was in reality under the latter's domination due to the hierarchy of functions and subordination[218]. Deprived of his or her work instruments (land for the peasant, tools for the craftsman), a worker was obliged to sell his or her labour power[219]. This has been referred to as a modern form of voluntary servitude[220] or modern-day slavery[221].

Capitalism found the means to prosper in the momentum of the first two industrial revolutions. Machinery developed from the 18th century onwards: weaving machines, flax spinning machines, cloth printing rollers, etc.[222]. The invention of these machines, the substitution of coal for charcoal to process ore and obtain cast iron, and the perfecting of the steam engine, favoured the advent in England of what was called the (first) industrial revolution which covered the period from 1760 to 1850[223]. This revolution spread to continental Europe and the United States and led to the formation of new industries, such as the cotton industry, the steel and metal construction industries, and the start of the great railroad construction works[224]. At the beginning of the 19th century, the invention of the steam locomotive

213 Dewerpe, p. 72; Méda, p. 15; Mercure, pp. 107 and 111.
214 Aubin/Bouveresse, N 119; Dewerpe, p. 81.
215 Méda, p. 45; Timbal/Castaldo, p. 567.
216 Aubin/Bouveresse, N 121; Dubler, Droit du travail, p. 3.
217 Méda, pp. 46-47.
218 Witzig, Droit du travail, N 41.
219 Aubin/Bouveresse, N 136.
220 Le Goff, p. 121.
221 See Perrenoud, pp. 81-82.
222 Alba/Isaac, p. 719.
223 Alba/Isaac, p. 830.
224 Veyrassat, Révolution industrielle, p. 2.

made it possible to replace horses with steam engines[225]. The mid-19th century saw a new upsurge in machinery, which benefited both from the constant improvement of old inventions and the use of new ones. Such was the technological progress in Western society between 1850 and 1914 that a technical and industrial civilisation emerged[226]. This (second) industrial revolution resulted, among other things, from the perfecting of the steam engine, the possibility of transporting electric power over long distances, the use of internal combustion engines, the increasing production of petroleum, a new process for converting cast iron into steel, and the perfecting (railways, steamships) or creation (cars and aircraft) of new means of transportation[227]. The large central steam engine was gradually replaced by numerous small independent electric machines[228]. The second industrial revolution accentuated industrial concentration at the expense of artisan workshops and home-based work[229]. It favoured an important rural exodus, an increase in the urban population and the development of the working class[230]. From then on, a worker was defined as a person who was mainly engaged in physical tasks in a factory, hired under an employment contract that was subject to freedom of contract, but who was legally and economically highly dependent on his or her employer[231]. From the end of the 19th century onwards, the factory worker became the very type of the working person[232]. In 1914, the working class was the largest social group[233].

Factories gave wage labour its modern form[234]. One of the most important consequences of the development of factories was the introduction of regular working hours, which marked a significant difference with the organisation of work at home. Clocks were installed in factories[235]. Over time, the interchangeability of parts and the standardisation of tools allowed for standardised mass production[236]. From the first to the second industrial revolution, there was a shift from the non-durable consumer goods sector (textiles) to the manufacturing of durable goods (motor vehicles,

225 Alba/Isaac, p. 830.
226 Alba/Bonifacio, p. 946.
227 Alba/Bonifacio, pp. 946-949; Caron, pp. 31-133.
228 Valentin, p. 11.
229 Alba/Bonifacio, p. 955; Tanner, p.1.
230 Alba/Bonifacio, pp. 966-970.
231 Degen/Rippmann, p. 4.
232 Degen/Rippmann, p. 4.
233 Méda, p. 43.
234 Degen/Rippmann, p. 6; Mahon, p. 300; Rippmann, p. 7.
235 Olszak, p. 37.
236 Alba/Bonifacio, p. 955; Dewerpe, p. 103; Koller, p. 4.

sewing machines, household appliances) and equipment goods (chemicals, materials, machinery)[237]. Thus, in Switzerland, while factory work was essentially situated in the textile industry, it developed in other sectors from the middle of the 19th century onwards: watchmaking, machine tools, chemicals, food industry, etc.[238].

Industrial concentration was accompanied by the capitalist concentration of the means of production, the creation of private banks and insurance companies, and the development of capital companies[239]. New management rules were developed: double-entry bookkeeping, inventory, balance sheet, management committee responsible to a board of directors[240]. One sought also to improve the profitability of workers through new forms of work organisation: division of work between the various workshops of a same factory and allocation of specific tasks to each worker[241]. The theories of the Americans Frederick Winslow Taylor and Henri Ford were implemented. The engineer Taylor proposed a scientific method of work known today as *Taylorism*. The method sought to increase the productivity of a company by the optimal exploitation of workforces through an analysis of time and work movements[242]. The worker's movements were to be timed and superfluous ones eliminated; man was to function like a machine[243]. The profitability of the factory could be ensured by a strict vertical and horizontal organisation. First of all, it was necessary to ensure a vertical administrative organisation, i.e. to divide the work in such a way that each person, from the deputy director downwards to the lowest level, had as little responsibility as possible and could therefore devote himself or herself only to the task he or she was given. In addition, a strict separation had to be established between the conception and the execution of work: "*As far as possible, the workers, as well as the team leaders and the workshop managers, shall be completely relieved of organisational work as well as of all clerical work. All intellectual work shall be excluded from the workshop and centralised in the Work Distribution Department, so that the execution work is strictly reserved to the workshop managers and the team*

237 Veyrassat, Révolution industrielle, p. 2.
238 Koller, pp. 3-4; Mahon, p. 299.
239 Alba/Bonifacio, p. 956; Halpérin, pp. 114-116; Mahon, p. 299.
240 Aubin/Bouveresse, N 133.
241 Alba/Bonifacio, p. 956.
242 Dewerpe, p. 102; Fasel, p. 1.
243 See Alba/Bonifacio, p. 956.

leaders..."[244]. Finally, it was necessary to introduce differentiated wages, depending on the standardisation of the performed task and the workers' performance. As for Ford, the industrialist who founded the car manufacturer of the same name, he organised the car production line according to the optimal use of equipment, ensuring a continuous and uniform flow of production (*Fordism*)[245]. In France and Switzerland, these new forms of work became increasingly important in the 1920s[246].

In the first part of the 19th century, the number of workers in factories increased considerably[247]. Their social and economic situation was precarious (uprootedness, unsanitary housing, insecurity of employment, poor working conditions, low life expectancy)[248]. The term "proletarian class" (referring to the *proletarii of* the Roman Republic whose wealth was based solely on progeny) was used for all those whose only wealth was their labour power[249]. In the spirit of liberalism, protections for workers were almost non-existent. Moreover, following the abolition of the corporative system, workers were forbidden to form unions or to strike[250]. Furthermore, there was little protection against the hazards of life (illness, accident, unemployment or old age); most of the time, workers could only rely on themselves and their families[251]. Around 1830, poverty affected 10% of the population in Switzerland and up to 20% in some highly industrialised countries, such as Belgium and England[252].

Such excesses prompted reactions in the form of workers' revolts and proposals to combat the negative effects of capitalism. Some social reformers, called socialists from 1840 onwards, wanted the state to have a central role in directing economic life and for workers to be able to group themselves in free associations, i.e. trade unions[253]. Other more radical thinkers, called collectivist socialists or communists, wanted the collectivisation of the means of production and did not rule out the use of violence or revolution in order for the workers to seize power. Among the various theoreticians of

244 Taylor, p. 77.
245 Dewerpe, p. 103.
246 Aubin/Bouveresse, N 280 and 334; Veyrassat, Mécanisation, p. 5.
247 Alba/Isaac, p. 870.
248 Degen/Rippmann, p. 7; Dewerpe, p. 81; Mahon, p. 301; Perrenoud, pp. 81-82; Rappard, pp. 201-214; Witzig, Droit du travail, N 40.
249 Halperin, p. 128; Olszak, p. 8.
250 Alba/Isaac, p. 870.
251 Degen/Rippmann, p. 10; Mahon, pp. 298-299.
252 Mahon, p. 299.
253 Alba/Isaac, p. 871; Lallement, pp. 148-154.

socialism and communism, we shall mention the Scotsman Robert Owen, the German Karl Marx and the Frenchman Pierre-Joseph Proudhon. Owen, a wealthy industrial philanthropist and socialist theoretician, set out to free workers from their servitude[254]. To achieve this goal, one had to abolish management and wage labour and replace them with workers' production cooperatives, run by the workers themselves[255]. One could even hope for the creation of a federation of cooperatives on a worldwide scale: "*The federative union of these communes, in groups of ten for limited local objectives, in groups of fifty or a hundred for broader activities, and in groups of a thousand for higher interests, a union which will ensure peace and goodwill in all regions and climates, will be effected without difficulty. For it will be found that the supreme and permanent interest of every one will be most efficiently defended by these communes and federations of communes, without any limitation, until the people of the globe shall be cordially united in one family, where all shall be anxious to promote their mutual happiness*"[256]. In 1833, Owen created a union, the *Great United National Union*, which counted up to one million members[257].

As for Karl Marx, he pointed out that capitalist employers bought the workers' labour power and appropriated an unpaid part of their work[258]. He argued that capitalism favoured the transition from a logic of domination at work (in power relations) to a logic of domination in work (unfolding in the activity of work itself). This process was the result of three mutations: the division of labour, the relationship to machines and the dispossession of workers' knowledge[259]. To counteract these developments, Marx postulated the historical importance and primordial necessity of the class struggle[260]: "*The history of every society up to the present day has been the history of class struggles. Free men and slaves, patricians and plebeians, barons and serfs, masters of guilds and journeymen, in a word, oppressors and oppressed, in constant opposition, have waged an uninterrupted war, which was at times overt, at times covert; a war which always ended either in a revolutionary transformation of the whole class, or in the destruc-*

254 Alba/Isaac, pp. 839 and 873-874.
255 Lallement, p. 149; Morton, p. 39.
256 Owen, p. 148.
257 Alba/Isaac, p. 839; Morton, p. 40.
258 Spurk, pp. 134-135.
259 See Renault, pp. 26-28.
260 Renault, p. 19.

tion of both classes in struggle"[261]. Workers had to unite to wrest political power from the capitalist bourgeoisie and impose the dictatorship of the proletariat[262]. After the abolition of wage labour, work would become a creative freedom, the sole truly human activity[263]. At the request of communist workers from London, he wrote the *Communist Manifesto* in 1848 with the help of his friend Friedrich Engels[264].

Finally, Pierre-Joseph Proudhon made a name for himself with his pamphlet published in 1840 under the title *Qu'est-ce que la propriété?* In it he answered that property was theft: "*If I had to answer the following question, What is slavery? and if I answered with a single word, It is assassination, my thought would be at first understood. I would not need a long speech to show that the power to take away a man's thought, his will, his personality, is a power over life and death, and that to make a man a slave is to assassinate him. Why, then, to this other question, What is property? may I not answer in the same way, It is robbery, without being certain of not being heard, although this second proposition is but the first transformed?*"[265]. By only partially remunerating the productive force of the workers who were subordinate to him or her, the owner unduly appropriated a share of the wealth and created inequality in the exchanges[266]. In 1846, in his *System of Economic Contradictions*, he affirmed his ideal of justice that would be realised when associations of workers organised and federated themselves, in order to produce and exchange their products valued according to the amount of labour they would have required[267].

From the middle of the 19th century onwards, the socialist movement in Western Europe became a mass movement embodied in political parties (the Swiss Socialist Party was founded in 1888, the French Communist Party in 1920 and the Swiss Communist Party in 1921)[268]. The second Industrial Revolution and the concentration of workers in factories brought about a new solidarity of the working class so that the improvement of workers' working conditions became, from 1890 onwards, one of the pre-

261 Marx/Engels, pp. 2-3.
262 Alba/Isaac, p. 875.
263 Méda, pp. 18-20.
264 See Marx/Engels.
265 Proudhon, p. 1.
266 Lallement, p. 161.
267 See Alba/Isaac, p. 876; Lallement, pp. 163-164.
268 Alba/Bonifacio, p. 974; Degen, Mouvement ouvrier, pp. 6-8.

dominant national or international issues[269]. The workers' demands resulted in the recognition of the right to freely form trade union organisations (in Switzerland, in 1848; in France, in 1884) and the right to strike (in France, abolition of the offence of coalition in 1864 and explicit recognition of the right to strike in the Constitution in 1946; in Switzerland, the right to strike was only explicitly guaranteed in the Federal Constitution as of 1 January 2000 in Art. 28 para. 3 Cst.)[270]. In Switzerland, the major trade union and employer organisations came into being in the years 1870-1880 (1880 for the Swiss Federation of Trade Unions)[271]. In France, the *Confédération générale du travail* (CGT) was founded in 1895[272]. The newly created trade unions were able to assert their power to obtain improvements in workers' working conditions (increase in wages, reduction of the working day, compensation for victims of work accidents, etc.)[273].

The theses of class struggle and workers' internationalism flourished[274]. With this in mind, *the International Working Men's Association*, later called the *First International,* was founded in London in 1864. Karl Marx was its leading figure[275]. A "new international", later called the *Second International*, was founded in Paris in 1889[276]. In March 1919, Lenin invited communist revolutionaries from all over the world to Moscow to participate in the foundation of a new workers' international, the so-called *Communist International* (the Third International), whose aim was to promote world revolution[277]. A few months later, on 28 June 1919, the International Labour Organisation (ILO) was established in the Hall of Mirrors of the Palace of Versailles. This resulted in the creation and development of international labour law[278]. The Third International was followed by a Fourth International (*the World Party of Socialist Revolution*) founded in 1938 in Paris by Leon Trotsky[279].

269 Alba/Bonifacio, pp. 970-971; Dewerpe, p. 87.
270 Aubin/Bouveresse, N 252-253; Olszak, pp. 91-108; Supiot, Droit du travail, p. 55.
271 Mahon, p. 302.
272 Aubin/Bouveresse, N 254; Supiot, Droit du travail, p. 59.
273 Alba/Bonifacio, p. 972; Olszak, pp. 91-122.
274 Alba/Bonifacio, pp. 974-975; Bürgi, pp. 1-7.
275 Bürgi, p. 2.
276 Alba/Bonifacio, p. 975.
277 Bürgi, p. 4.
278 On the creation and development of the ILO, see Dunand/Witzig, pp. 1-85.
279 Bürgi, p. 4.

5.2. Legal regime

Whereas since antiquity labour relations had consisted of a multitude of variously regulated concrete tasks, the French Revolution established a unified concept of subordinate employment, governed by the principle of freedom of contract[280]. The various arts and crafts were merged into a single abstract notion, with labour being considered a quantifiable and exchangeable good[281]. Thus, the first civil codes, which were very liberal in their inspiration, devoted only a few provisions to the "contract for hire of services", a denomination inherited from Roman law. The principle of party autonomy was intangible[282]. The French Civil Code of 1804 contained only three provisions relating to this contract[283]! Article 1779, paragraph 1 defined the contract of hire of services ("*hire of labourers who engage in the service of someone*"). Article 1780 specified that one could only engage one's services "*for a specific period of time or for a specific undertaking*". The intent was to make it impossible to enter into a perpetual engagement and to re-establish serfdom[284]. Finally, the famous article 1781 placed suspicion on the worker by providing that the master was "*believed on his assertion*" in all matters relating to the wage (quantum, payment and instalments)! This form of inferiority was not without recalling the testimonial incapacity of the serf[285]. Similarly, in Switzerland, the first Federal Code of Obligations, adopted on 18 June 1881, included only twelve provisions devoted to the "contract for hire of services" (Articles 338 to 349 CO 1881)[286]. Article 338 defined the hire of services as "*a contract by which one of the parties obliges himself towards the other to perform certain personal services in return for a remuneration*". In essence, it was a liberal right of an essentially dispositive nature which the parties to the contract could in principle freely set aside[287]. The legislators were not concerned with a possible protection of workers[288].

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280 Méda, pp. 14-15; Witzig, Droit du travail, N 30.
281 Dewerpe, p. 73; Supiot, Droit du travail, pp. 11-12.
282 Timbal/Castaldo, p. 570.
283 French Civil Code, Paris 1804. See Olszak, pp. 27-30.
284 Aubin/Bouveresse, N 121; Olszak, p. 28.
285 Olszak, p. 29.
286 Federal Code of Obligations of 1881, Berne 1982.
287 Berenstein, p. 232; Mahon, p. 310.
288 Witzig, Droit du travail, N 38.

Wishing to stabilise and manage a workforce that was often rural in origin, employers sought to keep workers in the factories by imposing iron discipline and inhumane working hours. Given the cost, continuity and homogeneity of the machines, profitability of the factories required uninterrupted activity[289]. Thus, steam engines ran non-stop and gas lighting allowed for night work. Competition led employers to increase working hours and keep wages at the lowest possible level[290]. In this context, it is hardly surprising that in the early days of industrialisation daily working hours varied between thirteen and fifteen hours, sometimes even eighteen hours in some sectors[291]. Moreover, working conditions were deplorable (standing position, inhalation of harmful substances, insufficient ventilation, excessive humidity or heat)[292]. Throughout the 19th century there was a growing body of literature describing the working conditions of factory workers[293]. Engels himself dedicated a study to mechanised cotton mill labour: "*I must now demonstrate that society in England commits every day and every hour that social murder which the English workers' papers are right to call murder; that it has placed the workers in such a situation that they cannot remain healthy nor live for a long time; that it undermines little by little the existence of these workers, and that it thus leads them to the grave before their time...*"[294].

The factory system involved direct employer control over workers and the production process[295]. Between employer and worker there was a strong hierarchical, spatial and temporal bond of subordination. Workers were watched over by guards, even in the workers' housing complexes built next to the factories[296]. The organisation of the factory according to a star-shaped plan inspired by the English jurist-philosopher Jeremy Bentham (panoptic plan) made it easy to monitor workshops[297]. Entry into the factory had to be made through controlled passageways and according to a time mechanism meticulously regulated by the sound of a bell[298].

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289 Dewerpe, pp. 82-83.
290 Timbal/Castaldo, p. 567.
291 Aubin/Bouveresse, N 137; Mahon, p. 301.
292 Aubin/Bouveresse, N 137; Dewerpe, p. 81.
293 Méda, pp. 45-46; Supiot, Droit du travail, pp. 13-14.
294 Engels, p. 140.
295 Dewerpe, p. 82.
296 Olszak, p. 37.
297 Olszak, p. 36.
298 Le Goff, pp. 44-45.

Workers were subject to factory or workshop regulations which were published as posters, booklets or as a preliminary notice on the employment form[299]. Regulations were supposed to be incorporated into the employment contracts. Therein one could find a clause of such type: "*By the mere fact of accepting work in the factory, the worker, whoever he may be, engages himself to accept all clauses and terms and conditions of the present regulations, which will be communicated to him if he so desires*"[300]. Regulations were drawn up without consulting the workers. Employers were the sole "legislators" and "judges"[301]. They contained work rules based on the respect of schedules and the prohibition of anything that could hinder production[302]. For example, talking, reading, drinking or eating while working could be prohibited[303]. Regulations also included provisions on order, cleanliness, obedience to superiors and good morality both inside and outside the enterprise[304]. They also contained sanctions against employees considered to have broken the rules, ranging from some corporal punishments (for children), to fines and wage deductions that could amount to several days or even weeks of work, up to abrupt dismissal[305]. For example, one regulation provided for fines for showing disrespect, arguing, drunkenness, introducing alcoholic beverages or not executing work properly[306]. Equally significant in this respect, the Swiss government's draft of the Federal Act on Work in Factories of 1875 contained the following provision: "*Corporal punishment and punishments which lead to loss of liberty, as well as any treatment which offends the sense of honour, are prohibited*" (Art. 7 para. 4 of the draft)[307]. In the end, this provision was not retained as it was considered superfluous, since the mentioned behaviours were already sanctioned by the Swiss Penal Code[308].

As already noted in our introduction, labour law, understood as the law of worker protection, was born, in the context of the first and second industrial

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299 Aubin/Bouveresse, N 139.
300 Le Goff, p. 121.
301 Le Goff, pp. 52-58.
302 Halperin, p. 130.
303 Le Goff, pp. 46-47.
304 Degen/Rippmann, p. 7.
305 Halperin, p. 130; Olszak, p. 37.
306 See Le Goff, p. 55.
307 Cf. Federal Act on Work in Factories, Federal Council draft of 2 November 1875 and proposals of the National Council Committee of 4 May 1876, in: Feuille fédérale 1876 II 825, 834.
308 Report of the National Council Committee of 24 May 1876 on the draft law on work in factories, in: Feuille fédérale 1876 II 797, 806.

revolutions, to contain the excesses of liberalism[309]. State intervention was deemed necessary. Social legislation was adopted all over Europe from the last quarter of the 19th century onwards (labour law and social security)[310]. Labour law consists of three axes: public labour protection law, private labour law and collective labour law[311]. The first labour regulations covered in particular the duration of work as well as health and safety conditions to protect the workforce[312]. However, protections were doubly limited: they focused on industrial labour on the one hand, and on the other hand on people deemed to be the most vulnerable (children and women)[313], which incidentally had the effect of progressively excluding them from the world of salaried labour[314]. Thus, in France, the Act of 22 March 1841 regulated the work of children employed in factories and workshops (prohibition of the employment of children under eight years of age in establishments with more than twenty workers using engines; limitation to eight hours of work for children aged between eight and twelve and to twelve hours until the age of sixteen; prohibition of night work for children under thirteen, etc.)[315]. A threshold of twelve years was established in 1874 in the Act on the Work of Children and Underage Girls in Industry[316]. In 1892, a new Labour Act gave adult women the same protections as children, with a maximum of ten hours a day under the age of sixteen and eleven hours above that, a prohibition of night work, a weekly rest period and a prohibition of some types of work[317]. The 1841 Act is also known to have initiated the constitution of a labour inspection body which was subsequently organised by the 1892 Act on Child and Female Labour, which was amended several times[318]. The Act of 9 April 1898 on Work Accidents was also an important step forward. Accidents at work had previously been governed by the general principles of tort liability. The Act imposed strict liability on the employer, based on the occupational risk[319]. The idea of solidarity with respect to hazards of

309 Levi-Sandri, pp. 196-197.
310 Halpérin, pp. 132-142; Mahon, p. 308; Witzig, Droit du travail, N 49.
311 Perrenoud, pp. 10-19.
312 Halperin, pp. 139-142.
313 Méda, pp. 47-48; Olszak, pp. 52-56.
314 Dunand/Mahon, p. 110.
315 Timbal/Castaldo, p. 571.
316 Aubin/Bouveresse, N 274.
317 Aubin/Bouveresse, N 276; Halpérin, p. 140; Olszak, p. 55.
318 Aubin/Bouveresse, N 301-302; Olszak, pp. 65-66; Supiot, pp. 37-38.
319 Aubin/Bouveresse, NN 287-292; Timbal/Castaldo, p. 573.

working life flourished and gave rise to the first social insurance schemes and later to social security law[320].

It was not until the 20th century that generalised protection of the working and salaried population was gradually put in place[321]. In 1910, the first Act establishing a Labour Code was adopted[322]. Title II of the first book was devoted to the "*contrat de travail*" (employment contract), a concept derived from the economic vocabulary that had appeared in the 1900s[323]. However, it was not until the Act of 13 July 1973 that this term was definitively established, by systematically replacing the expression "hire of services" with "employment contract"[324]! Overall, French labour law was built up progressively in the 20th century according to the evolution of political and economic relations[325]. The layout and numbering of the Labour Code were profoundly modified in 2008[326].

Switzerland was a pioneer in the field of industrial legislation[327]. As a result of federalism, the first legislation was of cantonal origin[328]. For example, in 1846 the canton of Glarus adopted one of the first industrial legislations in Europe regulating not only child labour but also adult labour[329]. The Swiss Confederation, which was gradually given the competence to legislate on social law (labour law and social insurance law)[330], adopted numerous social statutes as from the last quarter of the 19th century[331]. The total revision of the Code of Obligations on 30 March 1911 marked an important change. The new code contained 44 provisions (Art. 319 to 362 CO 1911) devoted to the "employment contract", a new designation which has not been changed since. From then on, the employment contract was no longer considered to allow the employer to have possession of the worker's labour power; the latter promised to put his labour power at the employer's disposal, but he or she kept control of it[332]. The legislator introduced

320 Aubin/Bouveresse, N 293/300; Supiot, Droit du travail, p. 14.
321 Méda, p. 48; Olszak, pp. 56-64.
322 Aubin/Bouveresse, N 306.
323 Supiot, Droit du travail, p. 68.
324 Olszak, p. 82.
325 Supiot, Droit du travail, p. 15.
326 Supiot, Droit du travail, p. 33.
327 Dunand/Witzig, pp. 87-91; Witzig, Droit du travail, N 42.
328 Mahon, pp. 305-306; Perrenoud, pp. 84-93; Rappard, pp. 183-199.
329 Witzig, Droit du travail, N 42.
330 Perrenoud, pp. 23-29.
331 Mahon, pp. 304-318.
332 Berenstein, pp. 236-237.

numerous mandatory provisions to protect the worker[333]. One could speak of a form of "socialisation of private law" in the sense that private law lost its neutrality of sorts by moving away from the fiction of the egalitarian exchange between the parties to the employment contract[334].

In addition to this adaptation of private law, an Act of public law made its mark. Adopted by Parliament on 23 March 1877 and accepted by the people by a very small majority on 21 October 1877, the Federal Factory Labour Act of 1877[335] brought numerous protections and improvements for industrial workers[336]. According to an official report, the aim was to "*reconcile the interests of workers with those of employers and to create a better position for the working population in the State, without thereby undermining the foundations on which industry as a whole rest*"[337]. It set the maximum working time at 11 hours a day, 10 hours on Saturdays (Art. 11) and the minimum working age at 14 years (Art. 15 para. 1). The employment of women (Art. 14 para. 1) and young people under 18 (Art. 15 para. 3) at night or on Sundays was prohibited. As a result, women were excluded from wage labour and confined to their homes, families and households[338]. The Factory Act introduced, apparently as a world first (before the French Act of 1898), the principle of strict (no-fault) liability of the employer for occupational accidents and diseases[339]: "*If the exploitation of a factory causes the death of a worker or injuries, the owner is liable for the resulting damage, unless he can establish that the accident is to be attributed to the victim's own fault*" (Art. 4 para. 1). Factory regulations (Art. 7 and 8), the period of leave (Art. 9) and the payment of wages (Art. 10) were also regulated. The Factory Labour Act was revised several times[340]. In the major revision of 1914-1919, it was increased from 21 to 96 articles[341]. The maximum working time was lowered to 59 hours per week, i.e. 10 hours per day and 9 hours on Saturdays. The protection of women and children was improved. The 48-hour working week (6 days of 8 hours) was intro-

333 Berenstein, pp. 237-240; Perrenoud, p. 43.
334 Mahon, p. 314; Olszak, p. 80.
335 Cf. Federal Act on Work in Factories, Federal Council draft of 2 November 1875 and proposals of the National Council Commission of 4 May 1876, in: Feuille fédérale 1876 II 825.
336 See Mahon, pp. 309-309; Perrenoud, pp. 95-106.
337 Report of the National Council Committee of 24 May 1876 on the Draft Act on Work in Factories, in: Feuille fédérale 1876 II 797, 798.
338 Mahon, p. 300.
339 Berenstein, p. 230; Mahon, p. 309.
340 Mahon, pp. 312-313; Studer, Fabriques, p. 2.
341 Perrenoud, pp. 107-118.

duced. Subsequently, the scope of worker protection was extended through the adoption of several specific pieces of legislation: the Federal Act on Working Hours in the Exploitation of Railways and Other Transport and Communication Enterprises (1920), the Federal Act on the Employment of Young Persons and Women in the Arts and Crafts (1922) and the Federal Act on Weekly Rest (1931)[342]. Despite its gradual development, legislation for the protection of workers remained incomplete and deficient. It was not until the adoption of the Industrial, Crafts and Commercial Labour Act in 1964 that uniform protection for workers was introduced[343].

Finally, with the development of trade unions a particular institution was born, that of the collective contract[344]. In France, the Act of 25 March 1919 established the normative effect of collective labour agreements[345]. In Switzerland, the Code of Obligations of 1911 established the right of employers or employers' associations to conclude collective labour contracts with workers or workers' associations, containing rules on working conditions (Art. 322 para. 1 CO 1911)[346]. The Act provided that an employment contract between workers and employers bound by a collective contract was null and void insofar as it deviated from it (Art. 323 para. 1 CO 1911); the null and void clauses were replaced by those of the collective contract (Art. 323 para. 2 CO 1911). On 19 July 1937, the social partners in the metal and machinery industries signed a collective labour agreement that provided for absolute labour peace. This agreement was symbolically seen as the starting point for the principle of labour peace in Switzerland according to which collective conflicts between employers and workers should be resolved by negotiation (and not by means of struggle, such as strikes)[347]. Collective agreements proliferated after 1945[348]. In 1956, the Federal Act on the Extension of the Scope of Application of Collective Labour Agreements was adopted which set out and determined the applicable conditions for the extension decision[349].

342 Perrenoud, pp. 120-147.
343 Perrenoud, pp. 147-165.
344 Witzig, Droit du travail, N 47.
345 Aubin/Bouveresse, N 329-332; Supiot, Droit du travail, pp. 14-15.
346 Perrenoud, pp. 181-182.
347 Degen, Paix du travail, pp. 1-2.
348 Studer, Protection, p. 4.
349 See Mahon, p. 323; Perrenoud, pp. 182-183.

6. The female or male office worker

6.1. Historical context

As a result of the use of new forms of energy (nuclear and solar) and the development of automation (electronics and computers) from the 1960s onwards, the third industrial revolution first transformed industrial work and production methods, and then communication systems and the service sector[350]. A new organisation of production, based on the quest for optimal quality and reduction of costs and deadlines, came into being. Sometimes called *Toyotism*, because it was based on the model used in the Toyota factories, the world's largest producer of motor vehicles, this method advocated that only what was ordered and sold should be produced[351]. This model was discovered worldwide in the 1980s and 1990s, and it has since permeated all sectors of the economy[352]. The advent of digital technology was catalysed by the development of semiconductors, with the mainframe computer (1960s), the personal computer (1970s and 1980s) and the Internet (1990s)[353]. Overall, the third industrial revolution brought about the end of the predominance of the secondary sector in favour of the tertiarisation of the economy[354]. Thus, since the beginning of the 2000s, more than two thirds of employees work in services in France or Switzerland[355]. The office worker has thus become the typical employee. Whereas the factory worker was hired to perform concretely defined tasks for a short period of time, either by means of a fixed-term contract or an open-ended contract that could be easily terminated, the office worker will generally be recruited in the spirit of stabilisation and duration of the company's action, often by means of an open-ended contract whose termination will be subject to restrictions[356]. In France, the Act of 1982 established the employment contract of indefinite duration as the common legal form of employment relations[357].

350 Caron, pp. 435-467; Flichy, p. 8; Veyrassat, Révolution industrielle, p. 2.
351 Dewerpe, pp. 119-120.
352 Valentin, p. 18.
353 Schwab, p. 18.
354 Veyssarat, Industrialisation, p. 10.
355 Le Goff, p. 475; Méda, p. 43.
356 Méda, pp. 53-54.
357 Méda, p. 55.

Henceforth, work no longer consisted mainly of transforming a material: it had become more abstract[358]. The perception of wage labour and work changed. As the philosopher and sociologist Dominique Méda points out, from "*1930 to 1975, the 'wage labour society' was put in place, marked notably by the fact that the working population became predominantly salaried and that the wage-earning sector was no longer confounded, far from it, with the working-class population. In the space of a century, wage labour has gone from being an undignified condition to the most desirable state*"[359]. Moreover, in the 1960[s], strong economic growth and improvement in well-being changed the traditional concept of work. Sociological studies have highlighted both the desire for self-realisation in work and the wish for more leisure time[360]. In this context some talked about a shift from work-labour to work-fulfilment[361].

Thanks to the progress made in electronic data processing, automation has made it possible to radically change the organisation of companies which are dependent on an increasing amount of information (large banks, insurance companies, retail trade, public enterprises, etc.)[362]. Information technology is the main working tool for office workers. In many sectors of the economy, this technology has made it possible to increase interactivity, productivity and profitability. It has facilitated the flexibilisation of work processes and increased the takeover of work organisation by the employees themselves[363]. There has been a kind of individualisation of working relationships, with each employee being assigned separate objectives and specific remuneration[364]. This individualisation has led to a personal assessment of skills and a recognition of individual rights[365]. It is thus up to the employee to defend his or her own interests, which become irreducible to collective interests[366]. Aurélien Witzig observed a degree of return to the 19[th] century model based on the contract as opposed to the law and collective rights[367].

358 Méda, p. 43.
359 Méda, p. 52.
360 Rippmann, p. 9.
361 Méda, p. 4.
362 Veyrassat, Mécanisation, p. 4.
363 Tanner, p. 4.
364 Méda, p. 70.
365 Le Goff, pp. 516-525; Witzig, Droit du travail, N 68.
366 Witzig, Droit du travail, N 69.
367 Witzig, Droit du travail, N 68.

6.2. Legal regime

The 1970s marked a turning point in the regulation of labour law. In the preceding decades, since the end of the Second World War, developed countries had enjoyed a buoyant economic climate with rising living standards and full employment (period of the so-called "*Trente Glorieuses*", i.e. the three post-war decades of massive economic growth).

Protection against dismissal was thus not a priority. In Switzerland, a comprehensive revision of employment contract law was undertaken in the 1960s. The revision was designed to adapt labour law to the economic and social changes that had occurred since 1911 and was adopted in 1971[368]. It was no longer aimed solely at protecting workers, as had been the case in 1911, but also at providing some protection for employers[369]. As regards workers, it was necessary to take account of the employer's power of management which placed them in increased legal dependence. The revision should therefore make it possible to strengthen the protection of their health and personality rights. As for employers, confronted with overemployment, they found it difficult to recruit workers. In order to protect the employer as well, the legislator adopted rules to prohibit the termination of the employment contract by the worker at an inopportune juncture and to sanction the worker who did not enter into service or abandoned his or her employment. In addition, many provisions were henceforth considered "absolutely imperative", i.e. the parties could not derogate from them either to the detriment of the employer or to the detriment of the employee (parity protection)[370].

In 1973, the massive rise in oil prices (oil shock) provoked a major economic crisis and a sharp increase in unemployment throughout the industrialised world[371]. This economic downturn made it necessary to strengthen the protection of workers against dismissal. In France, the 1973 and 1975 reforms relating to individual dismissal and economic dismissal made the freedom to terminate an employment contract of indefinite duration a legal act that had to comply with substantial rules of both substance and form: henceforth, a dismissal had to be motivated by objective circumstances

368 Berenstein, pp. 242-253.
369 Mahon, p. 325; Perrenoud, pp. 45-50.
370 Berenstein, pp. 251-253.
371 Mahon, p. 327; Méda, pp. 57-60.

(real and serious cause or economic cause)[372]. In Switzerland, shortly after the 1971 revision of the Code of Obligations came into force, the economic downturn prompted the necessity to strengthen the protection against dismissal. After various twists and turns, in 1988 Parliament adopted new provisions on protection against unlawful termination (Art. 336-336b CO) and termination at an inopportune juncture (Art. 336c CO)[373].

The lightning development of information technology has made employees more autonomous and efficient. At the same time, however, it has generated major risks, both for companies (theft or destruction of data, damage to reputation, etc.) and for employees (lack of control over working hours, abusive surveillance, intrusion into the private sphere, stress, moral harassment, etc.)[374]. Computerisation has contributed to a profound transformation of working relationships[375]. Indeed, new technologies are making the notions of place and time of work less certain[376]. It is now possible to access the resources of the company's network by connecting to the Internet from any location. Work may thus be carried out in a location other than the company, for example at the employee's home (teleworking) or in different premises where the employee is located ("satellite office", "nomadic work")[377]. The period of the Covid-19 pandemic in the early 2020[s] accelerated the use of teleworking, which became either mandatory or strongly recommended, to combat the spread of the virus. Working hours and working time have also become more flexible or uncertain, as it has become common to carry out work outside the initially agreed schedule using the technological means available. In addition, more and more employees have a free or atypical work schedule that allows them great flexibility in the organisation of their work, with the risk of a harmful weakening of the boundary between the professional and private spheres[378].

As the jurist Jacques Le Goff has pointed out, the "*employment contract is evolving into a contract for the provision of services, freed from the reference to time, so that activity will be assessed more in terms of results than in terms of the time devoted to achieving them. A considerable change! Should one conclude that subordination has ceased to exist, falling victim*

372 Méda, pp. 54-55.
373 Perrenoud, pp. 54-56.
374 Dunand, pp. 34-35.
375 Dunand, p. 35.
376 Barth/Wildhaber, pp. 128-129; Le Goff, pp. 523-525.
377 Dunand, p. 35.
378 Dunand/Mahon, pp. 112-113.

to a groundswell of autonomy that is progressively moving the status of employee towards that of the self-employed? Nothing is less certain. On the contrary, many indications suggest that, far from disappearing, it has been euphemistically rearranged by a process of internal re-composition that has given it new clothes that are lighter than in the past, but in reality still fit well, or even better than ever"[379].

According to the Social Chamber of the French Court of Cassation, "*the link of subordination is characterised by the performance of work under the authority of an employer who has the power to give orders and directives, to control their execution and to sanction breaches*"[380]. This link has two main aspects, a link of obedience resulting from submission to others (personal subordination) and a link of belonging resulting from integration into an organisation (organisational subordination)[381]. Thus, the Swiss Federal Supreme Court (the country's highest judicial body) defines the subordination relationship characteristic of the employment contract as the relationship which places the worker in the dependency of his employer from a personal, organisational and temporal point of view and, to a certain extent, from an economic one[382]. Over time, the notion of subordination has been broadened[383] or diluted in the sense that it now includes workers who enjoy real freedom in the performance of their work[384]. The Swiss Federal Supreme Court, for example, has clarified that the criterion of (personal) subordination should be relativised for workers who exercise managerial functions or liberal professions (lawyers, doctors, veterinarians, etc.). Indeed, for these workers, who enjoy real independence, subordination is essentially organisational[385]. In order to assess the existence of a subordination relationship, the overall picture of the service provider's integration into the company must be considered[386]. In France, too, labour law places great emphasis on the idea of functional subordination, making integration into an organised service an indication of legal subordination[387]. Thus, the broad autonomy conferred on this type of employee (particularly as regards

379 Le Goff, p. 525.
380 Société générale judgment of 13 November 1996, nº 94-13187.
381 Supiot, Droit du travail, pp. 69-70.
382 ATF 121 I 259, c. 3a; TF 4A_53/2021 of 21 September 2021, c. 5.1.3.1.
383 Etemi, pp. 75-77; Witzig, Ubérisation, pp. 464-466. For an in-depth study of the components and evolution of the notion of subordination relationship in Swiss law, see Billarant's thesis.
384 Supiot, Critique, pp. 165-166.
385 TF 4A_592/2016 of 16 March 2017, c. 2.1.
386 TF 4P.83/2003 of 9 March 2004, c. 3.2.
387 Supiot, Droit du travail, pp. 70-72.

the time, place and means of work) does not have the effect of eliminating the link of subordination, but rather of displacing and recomposing it. This link is incorporated into the very act of work (submission to production standards and deadlines, quota or results clauses)[388]. Finally, subordination takes the form of economic dependence in some cases. According to the Swiss Federal Supreme Court, it is decisive that, in the context of the service that the worker has to carry out, other sources of income are excluded and that he or she cannot, by his or her own business decisions, influence his or her income[389].

In reality, the development of polyvalence and employee autonomy has gone hand in hand with continued or even increased control over work[390]. The spread of digital tools has even increased the possibilities of control and surveillance of employees[391]. The mobile phone, for example, has generated a form of subordination extended to the whole of the employee's existence, when he or she has to be reachable or "*exploitable [corvéable] at all hours*"[392]. The worker "*is [...] treated like a programmable machine, expected to react instantly to the signals with which he is bombarded*"[393]. Similarly, computer technology allows for real-time monitoring of all of the employee's activities when using his or her computer[394].

7. The female or male service provider of a digital platform

7.1. Historical context

Over the past thirty years, globalisation has increasingly manifested itself as a process of economic globalisation and exacerbated competition under the hegemony of multinationals and international financial capital[395]. New forms of organising work have enabled companies to be more responsive to customer demands and the vagaries of the activity. We have moved from a regime in which production (supply) had control over time to one in which

388 Le Goff, pp. 525-529.
389 TF 4A_365/2021 of 28 January 2022, c. 4.3.2.
390 Méda, p. 70.
391 Méda, p. 112.
392 Le Goff, p. 527.
393 Supiot, Droit du travail, p. 74.
394 Le Goff, p. 528.
395 Dewerpe, pp. 120-121; Méda, pp. 60-61.

it is subject to the external constraint of diversified and volatile demand[396]. Various forms of flexibility have developed: internal flexibility (organisation of working time, technical organisation), external flexibility (fixed-term contracts, temporary work, part-time work, on-call work, teleworking, dismissal), externalisation (subcontracting, outsourcing) and relocation[397]. As the sociologist Patrice Flichy has found, the "*new economic model is no longer that of large, stable organisations, but that of momentary and atomised workers offering their production on the market*"[398].

These issues have been further exacerbated by the innovations of the fourth industrial revolution. This revolution, sometimes called the "4.0 revolution", is not the result of the use of a new form of energy, like the three previous ones, but of a merger of technologies from the physical, digital and biological worlds (computer science, artificial intelligence, robotics, the Internet of Things, 3D printers, biotechnologies, materials science, etc.), which ensures a convergence between the virtual (digital) and actual (production of objects) world[399]. All the elements involved in production communicate in real time and are capable of self-regulating by means of codes and algorithms. The 4.0 factory allows for the production of single objects at the same cost as mass production, and with a reduced number of people employed[400]. *Toyotism* is said to have been succeeded by *Teslism*, a disruptive organisational system adopted within the Californian start-up producing Tesla cars, created by Elon Musk. The following characteristics have notably been associated with it: the creation of a usage value by taking advantage of the hyper-connection of people, machines, and products, the hybridisation of traditional professions with digital ones, a limitation of energy consumption, and a management style inspired by the state of mind of *start-ups* and based on the responsibility of teams[401]. Technological progress linked to the computing power of computers is exponential and machine learning technologies are making lightning progress[402]. The labour world is increasingly using algorithmic techniques (health professionals, lawyers, digital platform workers)[403]. Algorithms are used, for example,

396 Le Goff, p. 505.
397 Dewerpe, pp. 123-126; Le Goff, pp. 486-496; Méda, p. 61; Supiot, Droit du travail, pp. 17-18; Witzig, Droit du travail, N 68-70.
398 Flichy, p. 8.
399 Schwab, pp. 11-40.
400 Kohler/Weisz, pp. 28-34.
401 Valentin, pp. 34-212.
402 Gamet, p. 775.
403 Gamet, pp. 775-782.

to manage all stages of the employment relationship (recruitment, career management, and possibly dismissal)[404].

One may wonder whether robotisation and platformisation ("uberisation") will lead to the disappearance of work or rather the disappearance of workers (advent of a *jobless* or *post-work* world[405]? A robot is a mechanical object capable of perceiving the world automatically, analysing data and acting accordingly. When given artificial intelligence, a robot may be endowed with reasoning, adaptation, and learning capabilities that are similar to human capabilities[406]. It is now being used in all economic sectors at an exponential rate[407]. Many tasks traditionally performed by employed people are now provided by robots (screening applicants, hiring, instructing other robots or employees, etc.)[408]. According to some studies, one in two workers could be replaced by robots in the next few years[409].

While robotisation replaces employed people with objects, "uberisation"[410] leads to the erasing of workers in favour of pseudo-independent persons or, as the sociologist Antonio Casilli has put it, to "*weaken work in order to better evacuate it as a conceptual category and as a productive factor to be remunerated*"[411]. Uberisation is a neologism used to describe digital platforms that operate with algorithmic matching systems that can be consulted on the Internet and that allow for direct, almost instantaneous contact between service providers and consumers or service seekers[412]. The word stems from the American company Uber, one of the first players in the field of chauffeur-driven cars. Henceforward, platformisation of work no longer only concerns personal transport or home delivery of meals, but also a large number of other services (accommodation, personal assistance, homework services, etc.). Among commercial platforms, a distinction is made, based on the criterion of the place of performance of the service, between on-demand work platforms (*Gigwork*) and participatory work platforms (*Cloudwork*). The former concern situations in which a service is performed outside the Internet, at a specific location and sometimes at an

404 Gamet, pp. 780-781.
405 See Casilli, p. 241; Witzig, Uberisation, p. 458.
406 Wildhaber, pp. 202-204.
407 Wildhaber, pp. 204-207.
408 Wildhaber, pp. 208-213.
409 See Méda, pp. 83-84; Schwab, pp. 51-54.
410 On the concept, see Witzig, Ubérisation, pp. 457-459.
411 Casilli, p. 22-23.
412 Casilli, pp. 97-118; Flichy, p. 368; Kohler/Weisz, pp. 34-36; Méda, p. 106; Schwab, p. 79; Wyler/Heinzer, p. 32.

agreed time (hospitality services, transport of persons, logistics services, personal services, etc.)[413]. As for the latter, they concern situations in which the service is performed entirely on the platform itself through the Internet. They can therefore be carried out from any location with a connection and the necessary computer equipment[414]. Thus, digital companies entrust (or allow access to) a multitude of small, often tedious and repetitive tasks to Internet users from all over the world, sometimes called "click workers", who use the platforms to sell their labour power (*click work*, *micro-labour*)[415]. This involves, for example, transcribing consumer panel purchases, digitising business cards, deciphering a sound recording or answering a survey[416]. These services enable the building of large databases and contribute to the improvement and mobilisation of artificial intelligence. They are most often poorly paid (by task and not by time) since they are fixed on the basis of top-down auctions which stabilise the price in relation to the proposal to work at the lowest price[417]. As Dominique Méda has pointed out, this process "*consists less of a major replacement of the human by the machine than of the invisibilisation and underpayment of work that is now done outside the wage-earning sector and at home*"[418]. But situations vary greatly. Some service providers who are capable of creating high added value are able to negotiate their working conditions and pay. This may be the case in the engineering, electronics, robotics, legal consultancy, data science or software development sectors[419].

By promoting self-employment and multi-activity, digital platforms are changing the employment relationship[420]. Admittedly, platform service providers currently make up a small proportion of the working population. Platform service providing is often a secondary activity that is carried out in addition to another dependent or independent activity[421]. However, it is likely that the platformisation of social and economic relations will progress in such a way that it may one day become the dominant mode of labour relations!

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413 Billarant, pp. 337-340.
414 Billarant, pp. 333-337.
415 Barth/Wildhaber, p. 130; Casilli, pp. 119-161.
416 Flichy, pp. 373-374.
417 Flichy, p. 374.
418 Méda, p. 107.
419 Dunand/Mahon, p. 115.
420 Dunand/Mahon, p. 114.
421 Flichy, pp. 377-380.

7.2. Legal regime

Platform owners require service providers, at the time of hiring, to accept non-negotiable general terms and conditions (pre-formulated standard contracts) containing, inter alia, a clause on applicable law (e.g. Dutch law) and arbitration (e.g. exclusive jurisdiction of an arbitrator in Amsterdam), and according to which they acknowledge that they are independent "partners" or self-employed entrepreneurs (or micro-contractors)[422]. Platforms thus intend to free themselves from the obligations of an employer (working hours, minimum wages, health protection, etc.) and from the payment of social security contributions[423]. Moreover, they exert a form of unfair competition on established trades and regulated professions (e.g. taxi drivers)[424]. They also purport to avoid the application of the rules of the State of the place of performance of the service and to deprive service providers of their natural forum[425].

In recent years, digital meal delivery and private transport platforms (most often Uber) have been in the media spotlight. In many countries there are disputes about the legal contours of platformisation[426]. Are service providers acting as independent self-employed entrepreneurs (or partner-entrepreneurs who would be "their own employers"), as the platform owners claim, or as dependent workers[427]? We shall refer to two major recent decisions in France and Switzerland concerning Uber drivers in which the high courts reached the same conclusions.

In a judgment of 4 March 2020, the French Court of Cassation considered that the micro-entrepreneur status of a driver was fictitious. The service provider had been operating as a driver from 12 October 2016 using the digital platform Uber, after renting a vehicle from a partner of this company and registering as a self-employed person, under the activity of passenger transport by taxi. In April 2017 his account on the Uber platform was deactivated. The driver applied to the labour court to have his contractual relationship with Uber reclassified as a contract of employment and to claim back pay and severance pay. In summary, the Court found that the driver had performed work under the authority of

422 Casilli, pp. 263-266; Wyler/Heinzer, pp. 32-34.
423 Méda, p. 108; Witzig, Ubérisation, pp. 460-462.
424 Flichy, pp. 362-369.
425 Aubert, Uber, pp. 10-11; Cirigliano, pp. 263-268; Wyler/Heinzer, pp. 37-40.
426 See Aubert, Uber, p. 8; Dunand/Mahon, p. 114.
427 See Casilli, p. 250; Zein, pp. 149-155.

an employer (Uber) who had the power to give orders and instructions, to control their execution and to sanction breaches. These considerations were based in particular on the following elements: the driver had joined a transport service created and entirely organised by Uber, a service that existed only thanks to the platform, through the use of which he did not constitute his own clientele, did not freely set his fares or the conditions of exercise of his transport service; the driver was imposed a particular route which he was not free to choose and for which fare corrections were applied if the driver did not follow the route; the final destination of the journey was sometimes not known to the driver, who could not really choose freely, as an independent driver would, which journey was suitable or not; the company had the option of temporarily disconnecting the driver from its application if three or more journeys were refused, and the driver could lose access to his account if he exceeded a rate of order cancellations or reported "problematic behaviours"[428].

In a judgment of 30 May 2022, the Swiss Federal Supreme Court (the country's highest judicial authority) reached similar conclusions: "*In view of the established facts, it is not arbitrary to consider that the drivers heard by the Cantonal Labour Office had provided a paid work performance for [the Uber company] on a durable basis, since they had carried out hundreds of journeys in return for a price fixed unilaterally by it. In addition to the fact that [the company] has complete control over the prices of the journeys, it follows from the judgment under appeal that it regulates precisely the way in which the transport service is to be provided, in particular by giving instructions as to the vehicle and the behaviour to be followed by the drivers, and by fixing the route to be followed. Drivers are not free to organise their work once they are connected to the platform, and repeated refusals to provide transport are punished by deactivation of the account for a fixed period. Geolocation also makes it possible to monitor the activity of drivers. In particular, a route deemed inefficient may be sanctioned by a reduction in the price of the journey. Drivers are also controlled and monitored via the rating and complaint system, bearing in mind that they do not have the possibility of knowing the author of a rating or complaint and that an account may be deactivated while the complaint is being processed, at the sole discretion of [Uber]*"[429].

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428 French Court of Cassation, Social Division, judgment nº 374 of 4 March 2020.

429 Swiss Federal Supreme Court, judgment of 30 May 2022 in case 2C_34/2021, c. 10.2. For a commentary on this judgment, see Magoga-Sabatier.

As these high courts have noted, Uber exercises, through the intermediary of algorithms, a power of direction, control, evaluation, and sanction which are characteristic of the link of subordination specific to the employment contract[430]. Numerous direct constraints weigh on the service providers (tasks to be carried out according to a rhythm and order established by the algorithm, time and place constraints, imposition of the price of the journeys, obligation to report, etc.)[431] who are additionally constantly monitored in real time[432].

Algorithmic (or technical) subordination is more generally characterised by the fact that it is not the employee or the employer who defines how the work is to be performed, but the algorithm[433]. It concerns digital platform providers as much as workers who make delivery rounds or order pickers[434]. "Algorithmic management" ensures that service providers deliver a responsive, consistent and standardised service[435]. As Supiot has forcefully pointed out, "*instead of thinking of the computer as a means of humanising work, one thinks of the worker on the model of the computer - programmable and reactive 24 hours a day*"[436]. Some have seen in this the desire to push "the logic of Taylorism to the extreme"[437].

8. Conclusions

"Work evokes both the constraint, the strain of an activity that is not its own end, and the freedom, the creative act, that in accomplishing, man accomplishes himself. At times enslaving people to things, at times enslaving things to people, work makes the demiurge as it makes the slave"[438].

The vision of work as subservience runs through the history of our societies[439]. In our study, we have looked at six modalities of labour relations from Roman times to the present day, focusing on the nature of the worker's dependence on the person in whose service and for whose benefit

430 Méda, p. 108.
431 Billarant, pp. 395-406; Casilli, p. 255.
432 Casilli, pp. 259-263.
433 Gamet, p. 778.
434 Casilli, pp. 253-256; Gamet, pp. 778-779.
435 Witzig, Droit du travail, N 74.
436 Supiot, Critique, Preface to the third edition, p. XVI.
437 Witzig, Droit du travail, N 74.
438 Supiot, Critique, p. 3.
439 Casilli, p. 257.

he or she performs the work. For each period there is a common and a specific element. The common element is a relationship of dependence and personal subordination. This link is reinforced by a specific link of dependence or subservience:

- the female or male slave is subordinate to her or his master and to her or his condition as a chattel;
- the female or male serf is subordinate to her or his lord and to the land which she or he cannot leave;
- the journeywoman or journeyman is subordinate to her or his master craftsman and to the corporation that governs the trade practiced in the town concerned;
- the female or male factory worker is subordinate to her or his employer and to the factory machine;
- the female or male office worker is subordinate to her or his employer and to the company's computer program;
- Finally, the female or male service provider of a digital platform is subordinate to the owner of the platform and the algorithm by which it operates.

Thus, labour relations are characterised by a strong bond of legal (subordination) and economic (means of subsistence) dependence of one person, the worker, on another. Is there a way out of this model, which we have known at least since antiquity? Some note that an important transformation is underway in which co-production within value-creating platforms is tending to become an important modality for the performance of work. In such a context, where each person is his or her own employer, one may envision a society in which there would no longer be any hierarchy or subordination, nor any wage-earning system[440]. The work of the future would then hardly differ from leisure[441].

[440] See Méda, pp. 84-85.
[441] Méda, p. 4.

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Laudatio Geert Van Hove

Wouter Vanderplasschen, Elisabeth De Schauwer, Stijn Vandevelde, Ann Buysse

In March 2022, the Faculty of Psychology and Educational Sciences unanimously proposed to award a Sarton Medal to Prof. Dr. Geert Van Hove to the Sarton Committee because of his exceptional merits in the field of Disability Studies. These merits are evident in his academic work, his teaching and his social and scientific services. Geert Van Hove has many publications to his name, is a celebrated teacher and is often consulted as an expert by services and organizations, fellow researchers and policy makers.

We take you through the career of professor Geert Van Hove, highlighting a number of important milestones and achievements.

In 1980, Geert graduated as an orthopedagogue from Ghent University. Two years later, together with a fellow student, Nicole Saenen, he founded the non-profit organization Baken: a pluralistic supported living service for persons with intellectual disabilities in Ghent. He worked in this service from 1984 to 1989 as supervisor-coordinator.

In 1989, Geert became an assistant at the Department of Special Needs Education, the then Laboratory for Orthopedagogy and Ortho-agogy. He obtained his doctorate in 1991 with a PhD on the orthopedagogical significance of supported living services in Flanders (supervisor, prof. E. Broekaert). His doctoral study was shaped by an integration of practical work and the necessary theoretical foundations. The doctorate formed the basis for the development of supported living services in Flanders under then Minister of Welfare and Family Wivina De Meester.

In 1993, Dr. Van Hove became lecturer in "Ortho-agogics" at the Department of Special Needs Education of Ghent University. He also became head of the university-based services UCRO and UCBO, which specialized in the

orientation, training and guidance of persons with "a labour disability" and later evolved into Divergent, a service for workplace support of persons with any type of labour disability. Geert Van Hove's teaching and research are mainly focused on the support of persons with disabilities and inclusive education, on which he teaches several courses. He has been the supervisor of 24 successfully defended PhD dissertations to date.

In 2013, for the first time Geert may call himself professor of "Disability Studies", when he was appointed as extraordinary professor at the VU University of Amsterdam in the Department of Metamedics. His research there focused on fathers of children with disabilities, in collaboration with the Dutch umbrella organization Disability Studies in the Netherlands.

Until September 2022, Geert was teaching director at the Faculty of Psychology and Educational Sciences. As a gifted teacher, Geert's heart was always with teaching and supervising students, but in 2018 he became responsible for the quality of teaching and the introduction of distance learning in the faculty. He managed the switch to hybrid forms of education and from large to small groups due to the social restrictions in the corona period. He combined the position of teaching director with his teaching and research assignment at the faculty, which centers on Disability Studies. Geert Van Hove was the first to introduce this subject at a Flemish university and Ghent University is still the only academic institution to offer 'Disability Studies' in the curriculum of students in Educational Sciences.

Disability studies is a term that refers to a shift in thinking about people with disabilities. In Flanders and internationally, Geert Van Hove was at the forefront of this historic shift in thinking about and working with persons with intellectual and physical disabilities. His work starts from a human rights perspective, the Children's Rights Convention and the UN Convention on the Rights of Persons with Disabilities, from which he has emerged as a champion of the right to inclusive education and full participation in society. With his characteristic enthusiasm, Geert connects science and practice, people and ideas, with the intention of making a difference for persons with disabilities.

In relation to the history of Disability Studies, we would like to highlight five particular merits.

1. Already in the early 1990^{s}, Geert immersed himself in the new definition of intellectual disability, which no longer focused on intellec-

tual functioning and IQ, but also and especially on adaptive behavior in various life domains. He followed a training in the United States with the AAMR (American Association for Mental Retardation, later AAIDD (American Association on Intellectual and Developmental Disabilities) and then spread these ideas in Flanders. This new definition of intellectual disability emphasizes the mismatch between a person's competencies and limitations and society's expectations, rather than individual disorders and deficits. This fits strongly with the critical movement in orthopedagogical theory and the thinking of Geert's teacher Ad van Gennep.

2. During his American adventures, Geert became acquainted with the Quality of Life paradigm and Prof. Robert Schalock, an authority within the AAIDD in the United States. He initiated the Quality of Life concept in the research at the Department of Special Needs Education and was closely involved in the deinstitutionalization of the large institution Arduin in Zeeland (the Netherlands), where the classical institution gave way to living and working with support in the local community. He also co-founded the movement for self-advocates with intellectual disabilities in Flanders, Onze Nieuwe Toekomst (Our New Future).

3. Another important achievement is his contribution to inclusive education in Flanders. Already in 1998, Geert Van Hove wrote a policy advice together with Prof. Pol Ghesquière (KULeuven) and Prof. Frank De Fever (VUB Free University of Brussels) on the development of inclusive education. By looking at how children with disabilities can find their way in regular education and what support is needed for that, he became familiar with the Disability Studies movement which allows him to build an international network around inclusive upbringing and education.

4. Geert Van Hove introduced the subject 'Disability Studies' at the department and strengthened the link with orthopedagogics as an integrative action science. Disability Studies is about critically looking at the concept of disability from an interdisciplinary perspective and considering how we can maximize opportunities for persons with disabilities to participate in society. Thus, Disability Studies first became a subject in the program, later his area of study as a professor and eventually part of the name of the study program: "Clinical

Special Needs Education and Disability Studies." All this can be seen as the result of an intensive and constructive collaboration with his buddy Prof. Dan Goodley, a colleague working in Disability Studies at the University of Sheffield.

5. Finally, Geert is one of the experts on qualitative research in the Faculty of Psychology and Educational Sciences, more specifically on participatory research and arts-based research. His research focuses mainly on the lived experiences of people with labels and research conducted in close collaboration with parents of children with disabilities or with people with disabilities themselves. He does so together with the researchers in his research group, focusing on co-creation and authenticity.

Looking back at these accomplishments and Geert Van Hove's entire career at the Faculty of Psychology and Educational Sciences of Ghent University, there is so much more to tell. International awards, visiting professorships at domestic and foreign universities and the publication of important books, such as Disability Studies in the Low Countries; Inclusion (The Right of All Children); Person-centered Support and Quality of Life (with Jos van Loon); and Parenting under Pressure (together with Erik De Belie), about parents and children with disabilities. Today, we would like to give special recognition to your activities and achievements in the field of Disability Studies. This Sarton medal is well deserved, given your leading role in this area in Belgium and abroad, often commenting critically, but always in a very positive and constructive way. You are one of the founding fathers of Disability Studies in Flanders, helped to develop it further and in that sense you also ensured its future.

‘Disability Studies: even a young field of science has a history’

Geert Van Hove

1. Disability Studies: what are we talking about?

Disability Studies at Ghent University is best situated as the work of people who are trying to understand the very complex phenomenon of disability in Hannah Arendt’s’ way. They did and do not work in a “lab situation”; no… they do so in the tradition of the Special Needs Department at Ghent[1] by acting. [2]

[1] Prof. Dr. Maria Wens was the founder of a school and observation centre for children in Guislainstraat, work that was later continued by Prof. Dr. Stijn Vandevelde and Prof. Dr. Franky D’Oosterlinck – Prof. Dr. Eric Broekaert was the co-founder of TG De Kiem and the European Federation for Drug Counselling, work that is being continued by Prof. Dr. Wouter Vanderplasschen; I myself am a co-founder of vzw Baken, Service Assisted Living for people with intellectual disabilities; our Department and in particular Prof. Dr. Elisabeth De Schauwer are co-founders of the European Federation for Drug Counselling, work that is being continued by Prof. Dr. Wouter Vanderplasschen. I am co-founder of vzw Baken, service of supported living for citizens with an intellectual disability; our Department and in particular Prof.dr. Elisabeth De Schauwer works closely with Parents for Inclusion, our Department also works structurally with the self-advocacy movement of people with disabilities in Flanders “Onze Nieuwe Toekomst”.

[2] ‘Acting’ has a very specific meaning with Hannah Arendt. Arendt distinguishes labouring, working/making and acting. The latter brings people together to speak and take actions on matters that concern everyone in the community. Acting is the human activity that breaks routines that prevail in labouring and working. Something new is begun as if to remind us forever that human beings, though mortal, are not born to die but to make a beginning.... (3, 21-22)

This action is *fundamentally pedagogical*[3]; those involved do not look away, those involved are not silent, on the contrary: responsibility is taken every time.

These actions also never happen 'in isolation': people are only people *in relationship with* others. This acting is also always *'highly political'*. In the tradition of Franz Fanon (1) we work with and for people this writer saw situated in 'the zone of non-being. If in the following quote from Fanon 'blackness' is replaced with 'disabled' and 'anti-black world' with 'ableist world' people will immediately understand what we are talking about in Disability Studies. "... a zone of blackness honestly confronted with its condition in an anti-Black world. The anti-Black world, the only world we know, hides this non-being to the extent that it ascribes a place and role to abject blackness. But the truth is the zone of non-being..."

The above brings us to the following description of Disability Studies (in Education) as described by Susan Gabel (2, 1) : "...Disability Studies is an emerging interdisciplinary field of scholarship that critically examines issues related to the dynamic interplays between disability and various aspects of culture and society. Disability Studies unites critical inquiry and political advocacy by utilising scholarly approaches from the humanities, humanistic/ post-humanistic social sciences and arts. (When specifically applied to educational issues, it promotes the importance of infusing analysis and interpretations of disability throughout all forms of educational research, teacher education and graduate studies in education)..."

With these starting points in mind, it is easier to understand why we did not – like many of our UK colleagues – choose 'the social model about disability' as the all-explanatory solution. It also explains why we are not dismissive of introducing 'the body/bodies' within Disability Studies.

The above is also related to the fact that in Ghent, the choice was not made to link Disability Studies to the specific study of certain "clinical target groups", on the contrary. Disability in Ghent is not the direct translation of

[3] We fall back on Hannah Arendt again who states that (4, 167): ...It is in education that we decide whether we love the world enough to take responsibility for it and immediately save it from the ruin which, without that renewal, without the arrival of the new and the young, would be inevitable. In education, we also decide whether we love our children enough not to banish them from our world and leave them to themselves, nor deprive them of the opportunity to undertake something new – something not foreseeable by us. Pedagogy is thus linked to relationships, contexts, complexity and uncertainties. It cannot be understood by Disability Studies scholars in an individualistic view, an economic frame of mind.

"the old handicaps". On the contrary, "disability" is seen as a very dynamic phenomenon: a lived reality, a label, a social location, an embodied difference, a political identity, a creative expression.

2. Why are some doing research within the young Disability Studies tradition? A personal interlude.

In his recently published book ''Disability and Other Human Questions'', our colleague Dan Goodley exhorts us to reflect on the question why we want to engage in Disability Studies?: "...One comes to Disability Studies for numerous reasons. No one account is the same. And one person's narrative of engaging with Disability Studies can be told in different ways, depending on whom one is trying to impress[4]. Why should we contemplate disability and other human questions? If Disability Studies is a community of writers, political activists, and artists, then what brings us here? This question gives away as much as it demands. This question is one commonly asked in feminist, queer, black, working class, trans and other kinds of radical scholarship that exist as a consequence of oppression and are developed in responses..." (5, 1)

I came to Disability Studies as the grandson of a grandmother who had been admitted to a psychiatric institution for a long time after the death of her husband. This fact had a devastating effect on her family: her six (often still small) children were placed out of home. My father – one of those six boys and girls – lived for several years with one of his brothers on a farm owned by a relative, a man who was kind enough to house those two boys (meanwhile they could provide a lot of help on the farm). The story of my grandmother's collocation had a devastating effect on my father's dreams for his future (he wanted to become a teacher). My father held very clear opinions about 'family and upbringing': there would be no violence in the family context; it was best not to talk too much but to read a lot and listen to music; people given opportunities should fulfil their future dreams; children and grandchildren should be cherished. The consequences of the forced admission of my

[4] Dan Goodley links his personal story of his grandfather being difficult for many to understand after a brain attack (p.2) as well as his personal struggle with alcohol abuse (p.57) with his engagement within Disability Studies

grandmother play on in our family to this day, it is the story that everyone[5] (knows a little bit) but no one talks about in full. It inspired me to work with families and to ask critical questions about what institutions to for citizens. It made me write the following text about my grandmother.

Mémé, mother...

Two words that carry a deep family history,

A little boy turned into 'mémémoete',

A little woman with a terrifying life story.

Connected to many who, in the name of medical science, felt electroshocks go through their brains and were among the first to taste Largactil, Valium and Haloperidol....

Institutionalized, collocated, reduced to Untermensch

The little boy heard rumors about an institution, about 'the sisters', about 'the fools'.....

But he also saw how, with mathematical precision, you could cut a slice of bread just like that with a giant knife clamped against your round breasts and how you could knit beautiful woolen winter socks with the same precision....

So what was your diagnosis? Why did your children have to live without you for so many years? Why did you receive electroshocks? Why did you have to endure nightmares, keep seeing images of women coming back from 'treatment' with round prints on their foreheads.

Why is your story only whispered in the family?

Why, after two generations, do we still seem afraid to look your story and our history in the eye?

The woman as a dangerous creature, poor people first in line for incarceration, those who were not "learned", those who did not get protection,... Priests, notaries, mayors, doctors,...a company of men were ready to remove you and place your children with well-meaning mostly religious,

[5] For an interesting article about unspoken family stories: Rober, P. & Rosenblatt, P. (2016). "What was it like in the camp?". War memories and family secrets, *Systems Therapy*, jg.28, 2, 90-109.

gullible relatives. Uncles and aunts became replacement fathers and mothers for your children for years.

But none could replace you.

And then they released you....

Where were you supposed to go after all these years? Start over but how? And with what support and resources?

Mother became mémé, nursing mother to newborn grandchildren. Clumsily fixing what your own children didn't get bit bossy, bit 'crazy' (you might have had that crazy look in your eyes after all) always available.

Nomad from child to child.... Then starting your third life....

3. Disability Studies: a young field of scholarship with a history.

Writing the small history of Disability Studies as a non-historian posed a fascinating task. How exactly does one go about describing a history in this way? … was a question that largely helped determine the structure of this text.

To find an answer to that question, I put my ear to the ground of colleagues who have already made 'a more than great attempt'. One of my sources of inspiration (6) is Prof Dr Geert Buelens, Professor in Utrecht who works at the Institute for Cultural Studies Research.

About his book[6] Buelens explains that he wanted to write a world history of the 1960s using objects: films, books, music, supplemented by a study of the media of the time.

With Buelens' choice in mind, my attempt to describe the history of Disability Studies will be based on three pillars: describing objects of interest; discussing significant figures and outlining some events that have made a difference and then more specifically for Disability Studies at Ghent University.

6 (https://deburen.eu/magazine/2308/geschiedenis-schrijven-doe-je-op-dezelfde-manier-als-een-roman)

3.1. Disability Studies and objects of interest.

The three objects of interest that can help us shape that history are: the Museum Dr Guislain; the World report on Disability and the documentary Crip Camp.

3.1.1. Understanding history through objects: Disability Studies in Ghent cannot do without the Museum Dr Guislain.

For years, we have been sending our first-year students to the museum with one simple (now yes) assignment: go to the museum, choose one object, and try to connect this object with the question "what is normal? "Of course, this assignment is not an end, but a means to ensure that our students get to know the museum. After all, which museum offers more opportunities to organize a Disability Studies introduction? The switch from 'the institute' to 'a museum' by the initiators in the early 1980^{s} was a very significant decision. The representation of the significance of Dr Guislain's work as reflected in the buildings and in the historical collection is unparalleled. In its historical collection, for instance, the museum offers us a view on the coercive practices of previous centuries; it also shows and makes us feel how community life and communal labor were considered important parts of the 'moral treatment'. Nor should we lose sight of the fact that the hospital's first intended target group ('Hospice pour hommes aliénés') immediately exposed the relationship between 'mental illness' and 'social problems' in the city of Ghent.

Those who do not know this history (well) will, for example, when debates about 'isolation' (see recent dramas in Belgian newspapers such as Jonathan Jacob's) end up in an empty discussion rather quickly. Similarly, the whole discussion on social economy and support for certain 'target groups' is best situated with respect to the principles of moral treatment.

In addition to its historical collection, the museum also offers tremendous assets for learning about outsider art. This term goes back to 'the spontaneous and unconventional work of artists working outside the professional art circuit or operating on the margins of society'[7]. The Stadhof Foundation internationally renowned collection has been part of the museum since 2002. This collection – from naive art to art brut – has more than 6,000

[7] (https://www.museumdrguislain.be/nl/vaste-collectie)

works by almost 400 outsider artists. This latest collection and the permanent stream of temporary exhibitions allow 'disability' and 'mental health' to be viewed not only from a medical or socio-psychiatric perspective. Art and culture are imbued with images and conceptions of (ab)normality. Disability Studies is clearly related to these (as the museum itself describes it) contraire, brutal, utopian, creative and playful approach. Disability asks questions; disability opens new perspectives, disability (and so we come again to a statement by the museum) chafes and is a 'kick in the ass'.

3.1.2. Understanding history through objects: The World Report on Disability.

On 1 January 2011, the World Health Organisation and World Bank published the first World Report on Disability[8]. This Report is a very important object for Disability Studies.

The report (7, 8, 9) manages to be a meaningful piece of work at the intersection of Public Health, Human Rights and Development Cooperation. Succeeding in this is a 'tour de force', this because the preceding topics are often put into non-communicable categories.

The Report also manages to draw on as much 'evidence' as possible. In addition to working with professional experts, very close attention was paid to input from many Disabled People's Organizations. On the other hand, an attempt was made to estimate as accurately as possible the number of people who have a 'decrease in functioning' (in parallel with the WHO framework on disability). The latter includes people who do not immediately belong to the traditional target groups but who do experience a lot of problems in daily functioning (e.g. some people with diabetes, some people with heart disease, some people with mental health problems). With this the WHO arrives at an estimate that 15% of the world population has a disability and that 80% of those people live in 'developing countries'. (More than one billion as at 2011). Among these people, it is observed that: they are more likely to live in poverty; they usually have poor health and have to live with inaccessible health systems; they are poorly educated and face an inaccessible school system; and they are forced to live in a dependent position.

[8] https://www.who.int/teams/noncommunicable-diseases/sensory-functions-disability-and-rehabilitation/world-report-on-disability#

With its Report, WHO wanted to support national governments to implement the UN Convention (see elsewhere in this text). This support is based on specific concerns such as highlighting that disability is more prevalent in certain specific populations such as women, older persons, people living in poverty, people living in low-income countries. Moreover, the WHO states that the number of people with disabilities will increase soon.

In addition, WHO has also formulated initial advice that can be incorporated by countries to build their national plans/strategies. For instance, countries are encouraged to first and foremost build accessible mainstream support systems (people with disabilities often have ordinary needs). Countries are also advised to continue to pay attention to necessary specific programs (e.g. regarding vocational training) in addition to mainstream thinking.

This report is also a wake-up call for Disability Studies. Indeed, it establishes that many DS studies deal only with situations in the North and have largely middle-class people in their samples. Following this World Report, several interesting projects were set up internationally, not forgetting the journal 'Disability and the Global South'[9]. In Ghent, we have always tried to keep the bridge with the South open. For instance, based on PhD projects, we built up collaborations that gave us more insight into situations in, for example Ghana (10) and Uganda (11).

3.1.3. Understanding history through objects: the documentary 'Crip Camp'.

On the website[10] of the film 'Crip Camp', we read the following:" ...In the early 1970s, teenagers with disabilities faced a future shaped by isolation, discrimination, and institutionalisation. Camp Jened, a ramshackle camp "for the handicapped" (a term no longer used) in the Catskills, exploded those confines. Jened was their freewheeling Utopia, a place with summertime sports, smoking and make-out sessions awaiting everyone, and campers experienced liberation and full inclusion as human beings. Their bonds endured as many migrated West to Berkeley, California – a hotbed of activism where friends from Camp Jened realised that disruption, civil disobedience, and political participation could change the future for millions.

Crip Camp is the story of one group of people and captures one moment in time. There are hundreds, if not thousands, of other equally important

[9] https://dgsjournal.org/all-issues/
[10] https://cripcamp.com/

stories from the Disability Rights Movement that have not yet received adequate attention. We are committed to using the film's platform to amplify additional narratives in the disability rights and disability justice communities – with a particular emphasis on stories surrounding people of colour and other intersectionally marginalised communities. We stand by the creed of nothing about us, without us. For too long, too many were excluded, and it is time to broaden the number of voices…"

Including the Obamas as executive producers, this documentary was released in 2020 on Netflix (can also be found on YouTube[11]). Crip Camp helps us understand how a 'perfect storm' (in the right place, at the right time) can have far-reaching consequences. The young people at the hippy-style camp (counselors positioned themselves as friends/assistants rather than superiors – in the spirit of make love not war, many young people at this camp were having their first sexual experiences) later moved to Berkeley to make 'their cause' a 'political cause' in the schwung of protests as organized by the women's movement, by the nascent gay and lesbian movement, by the anti-war movement, by the movement of African Americans, by the global human rights movement.

As colleague Dan Goodley[12] rightly points out: this was actioneering based on the intersectional paradigm pure and simple. They did so making use of every possible technique (blockades of buildings and intersections – direct confrontation with policy makers) that civil disobedience makes available. Many of them became from 'disabled youth', leaders of an activist movement that, despite heavy resistance from the Nixon administration, eventually led to the ADA[13] (the Americans with Disabilities Act). The ADA required states to provide accessible environments and accessible public transport, among other things.

Those young people from the holiday camp later went on to study, they entered relationships, they became respected citizens in an American society that until then had treated people with disabilities very paternalistically. Not for nothing was the eugenics movement (12, 13, 14) very active in the USA; not for nothing were large institutes established in several states

11 https://www.youtube.com/watch?v=OFS8SpwioZ4

12 https://thesociologicalreview.org/magazine/june-2020/activism/crip-camp-a-disability-revolution-netflix-2020/

13 https://www.ada.gov/ada_intro.htm

(with major scandals[14] later discovered); not for nothing did children with disabilities in the USA attend segregated schools (15). This documentary is a gem of proper representation of persons with disabilities: those who are parents are parents (and the disability is not in the foreground); those who practice a profession do so because they have the expertise needed to practice this profession and not because they have experienced priority policies as persons with disabilities.

3.2. A small history and the importance of significant figures.

A limited number of significant figures are discussed below. These are people who have helped shape the field and who often did so from a combination of scholarly research and activism. We will successively introduce: Gunnar Dybwad, Steven Taylor, Rosemarie Garland-Thomson, Eva Feder Kittay and Subini Annamma.

3.2.1. Gunnar Dybwad (1909-2001).

Dybwad was an American academic and activist who stood up for the rights of people with intellectual disabilities.

He was one of those first advocates to consider questions about persons with intellectual disabilities not only from a medical perspective but also as a matter of human rights.

[14] https://www.disabilitymuseum.org/dhm/lib/catcard.html?id=1782 and (http://www.preservepennhurst.org/default.aspx?pg=1643) Christmas in Purgatory. The reality of Life in an institution is a photographic essay by Burton Blatt and his friend-photographer Fred Kaplan. On these links we could read the following about this book: During the Christmas season of 1965, Burton Blatt was a participant in a research project at a Connecticut centre for the developmentally disabled when he undertook a bold venture. He and his friend, photographer Fred Kaplan, gained access to five state institutions for the developmentally disabled in four eastern states. Unbeknownst to the staff at these institutions, Fred Kaplan carried a miniature spy camera on his belt and secretly snapped pictures as they toured the back wards of the facilities. Moved to despair over what they had seen and documented, the two men self-published *Christmas in Purgatory* in 1966. They printed one thousand copies and distributed them, free of charge, to legislators, university professors, and the fledgling mental health advocacy groups of the time. It was the first time many Americans had seen the horrors of institutional life and response to the book was so remarkable *Christmas in Purgatory* was selected for print by Allyn and Bacon publishers later that year.To protect those affiliated with their project, Burton Blatt and Fred Kaplan never disclosed the names of the institutions they visited so it isn't known whether Pennhurst was among them. But what is certain is that Pennhurst was not unique. The conditions depicted in *Christmas in Purgatory* are common wherever people are housed in institutions.

Originally of German origin, Dybwad studied law in Halle, where he also obtained a PhD. Afterwards, he emigrated to the US where he graduated from the New York School of Social Work.

Early in his career, he studied the criminal justice system in fascist-oriented states with a particular focus on the system under fascist rule in Italy.

Through his directorship of several organizations (Child Welfare program in Michigan, the National Association for Retarded children, the Child Study Association of America) between 1943 and 1963, he became an internationally recognized leader in the field of care and support for persons with disabilities. He became a major advocate for disability rights, and for ethical and legal protections. From 1964 to 1967, Dybwad and his wife directed the "mental retardation project" of the International Union of Child Welfare, Geneva, Switzerland. In 1967, Dybwad also became the founding director of the Starr Center for Mental Retardation at the Heller School for Policy and Management at Brandeis University. He served as president of Inclusion International from 1978 to 1982. The organisation, which he and his wife co-founded, assisted parent and self-advocacy groups. He is known for his support of families of children with disabilities and with the development of young professionals in the field.

Dybwad retired from Brandeis in 1974 due to mandatory age restrictions. After leaving Brandeis, Dybwad taught a course on developmental disabilities at Syracuse University and was a lifetime Associate of the Center on Human Policy, Syracuse University. (It is at Syracuse University that we will also meet Steven Taylor later in this text)

Dybwad believed that people with developmental and intellectual disabilities best responded to integration into the community. Maximal integration meant providing these people with opportunities to live in "ordinary family settings," and have access to "typical community services".

Dybwad supported volunteer groups and citizen advocacy, whose purpose was to "demand and obtain" services for people with disabilities.

Besides these impressive biographical details that we can read on many information sites and Wikipedia pages[15] , we also learn from Dybwad's collected writings, what a 'seer' he was, long before there was Disability Studies. We would like to illustrate this with five 'revolutionary quotes' from his collected lectures notes (16)

- *"...First, you put on a label, and then subject your thinking to that label, and it becomes a vicious circle...".* (p.5) Dybwad always marveled at the artificial state of the terminology used. He was especially concerned about the negative perceptions such terms could create. And moreover, he warned everyone that a negative perception about someone, was always going to lead to 'a negative treatment'. *"...Thus, the way in which we treat the individual considered to be mentally retarded will have a definite effect upon his development...". "...So we considered those who scored below 70 on tests as 'mentally deficient' and placed them in institutions, indeed, once so placed they functioned after a while, as though they were mentally deficient...Therefore, it is important that we keep the individual in focus rather than a diagnosis..." (from a lecture in Montreal, 1963)*
- *"... the inherent dignity of any human being, no matter how severely disabled, cannot be quantitatively assessed, and to do so in the name of ethics (as has been tried) is a mockery of that term...".* Dybwad marveled very early on (1977 lecture, Philadelphia) at the very strong influence of bureaucracy on care and support. He therefore noted that certain logics came into play that seemed to lack any kind of direct contact with the reality of families of persons with disabilities. "*...Let me underline one point of wisdom from Lewis Carroll's* Alice in Wonderland*. I have often said that all administrators should have this book on their desk for easy reference. You may recall that Alice asked the Queen,* "Where shall I begin?" *and the Queen answered her,* "Begin at the beginning"*. In the field of disability we most certainly have failed badly in that respect. Early intervention is particularly essential..." (p.1)*

[15] https://en.wikipedia.org/wiki/Gunnar_Dybwad
https://www.britannica.com/biography/Gunnar-Dybwad
https://inclusion.com/marsha-forest-centre/in-memoriam/gunnar-dybwad/
https://www.lowellmilkencenter.org/programs/projects/view/dr-gunnar-dybwad-giving-a-voice-to-the-developmentally-disabled/hero
https://www.nytimes.com/2001/09/20/us/gunnar-dybwad-92-dies-early-advocate-for-the-disabled.html

- In the same lecture in 1977, Dybwad also revealed that he would not only support parents' groups in the future. He increasingly believed in 'self advocacy' as a source of information and action. "*...Much of my most significant learning in the field of disability I owe to parents of children with disabilities. But more and more I am convinced that we must listen to a far greater degree to the individuals with disabilities... What we call the inability of persons with severe disabilities to communicate may well be our ineptness in listening. So, we must learn to listen...". (p.1-2)*

- Throughout his career, Dybwad (like many in healthcare) struggled with the phenomenon of 'institutions'. In a lecture in Hartford in 1979, he relates the following: *"...I was involved (p.100) in designing a new type of institutional facility in Illinois for children classified as moderately and severely retarded; planned with free-standing houses for 8 children, sleeping two in a bedroom, and for these four bedrooms there were two regular bathrooms such as one would find in any family home. And there was a fully equipped kitchen to prepare food and a living and dining room. Let me admit, it only slowly dawned on me that if these children could live in this type of home, why have 50 of these houses all in one place away from the community?...."* On the other hand, Dybwad did not simply want to sell deinstitutionalisation as an 'empty box', saying the following about it: "*...(p.101) Too many of the present State efforts towards deinsitutionalisation have focused only on providing a substitute abode for the person to be moved out of institutions, with often grossly insufficient attention to the life-needs of disabled persons. Thus, parents and professional workers alike have complained that in many instances the person is merely moved from one larger institution to a smaller one, is left without adequate activity, guidance or supervision, still in relatively isolation from the rest of the community...'*

- Dybwad's insights (17, 43-44) on the education of children with (intellectual) disabilities are immediately applicable to current debates on whether special or inclusive education is the best option for children with disabilities. Read along: *"...Of all the deprivation and suffering to which these families were subjected, the refusal of school authorities to educate their children was the most difficult to accept...Parents started to organize classes under their own auspices or turned to private schools. Later when the financial burdens of these programmes became unbearable, the parent groups began to ask for public subsi-*

*dies...they gratefully received financial and other assistance from whatever ministry or department offered them...this partially explains the varied administrative arrangements under which special education has been conducted in various countries. Another reason is that the more severely retarded children were thought to be 'sick' and therefore were considered to be properly the responsibility of the departments of health for all their needs...when it became obvious that the children were by no means 'ineducable' as educators claimed for so long, parents and professionals in the field began to question whether these children did not have the same right to public schooling as other children... However, the picture became further clouded when, in various countries, at the request of parents and friends of the mentally retarded, legislation was introduced authorizing special education for one or another specifically designated group of retarded children. While this helped some of the children, it tended to reinforce in legislators and public officials the belief that the others indeed were ineducable and therefore not of concern to the educational authorities....*This description makes it clear that what we have now organised in terms of segregated education tries to support the right to education on the one hand. On the other hand, the organization of a parallel educational circuit – with mainly separate school campuses and separate developmental objectives instead of attainment targets – is one of the possible reasons why the social inclusion of people with disabilities – the utopia that Disability Studies strives for – has so far shown very poor results in Flanders (for more information on this, see the section on the first Statistical Report Flanders later in the text

3.2.2. Steven Taylor[16] (1949-2014).

Disability Studies received important impetus in the USA from the Center on Human Policy at Syracuse University. The Centre's director, Steven Taylor, became a prodigious mentor to many American and European colleagues. With his center, he opted for a humanities-based disability studies (17, 3-4) He showed great respect for illustrious predecessors from sociology, history, policy studies, etc. He was also the great advocate (including by being highly critical of the first to launch 'Crip Theory') for all of us to

[16] along with Elisabeth De Schauwer I once called Taylor – as an admirer – "a gentle anarchist".

continue to ensure that people with disabilities other than physical impairment would continue to find their place within Disability Studies. (17, 4)

Taylor initially made an immense contribution to the field through his publications. Julie Allan (19, 15-16) describes very precisely the standard 2000 article (20) in which Taylor reports on ethnographic research with a family (the Dukes). Allan refers to this publication as 'the gold standard of disability studies'. Taylor knew the family inside out and had frequent contacts with them. This taught him that the Dukes – just about all family members had a label of intellectual disability or mental health problems – managed to construct a collaborative world they both belonged to and constructed. Taylor showed the stark contrast between the familial identities and those constructed by the official identities. He identified four ways in which the family was able to 'avoid the stigma and stained identities' of disability. First, the unit of the family served to interpret and organise everyday meetings, away from institutional constructions; second, the family network was extended and broad, with concomitant resources to draw upon; third, the family was entirely separate from those institutions, agencies and organizations and from their attendant subcultures; fourth, the family members had acquired competence, not discernable through standardised tests in literacy or numeracy, but nevertheless allowing them to function effectively in the world. Taylor brought this study as a counter-narrative to the many studies that represented the more traditional perspectives of professional experts.

In addition to his important publications, Taylor also remained a real activist with his Centre. Via slogans ("Label jars not people") and community actions, he continued to warn against the disabling conditions created by decisions and actions of policy makers and experts. After all, it is those decisions that often decide whether someone falls 'within' or 'outside' the norm and may or may not participate. His center continued to point out the dangers of systematic oppression. (17, 6)

Taylor was also the chief editor of the authoritative journal Mental Retardation for many years. With his very particular approach, this academic journal became a source of 'gentle anarchy'. (Van Hove & De Schauwer (2021), in 17, 65) He managed to employ a kind of 'playfulness' to unmask a middle-class/bourgeois type of seriousness. (Van Hove & De Schauwer, in 17,66) A gentle anarchist is equally interested in what happens 'in the margins' than in the center. His keen interest in community and

its processes of inclusion and exclusion are legendary. Finally, he lived in a kind of heightened state of vigilance for signals that show the first cracks in bastions of power. Based on these features, articles were published that called (as the first) for taking seriously the perspectives of 'the target groups studied'. He also allowed articles that can at least be called controversial (21), but which also show how many layers can be traced in special phenomena as e.g. 'parents with intellectual disabilities'. Finally, articles were also published that showed characteristics far beyond the standard format of a scientific article. Phil Smith's 'Inquiry Cantos' (22) is a kind of precursor to academic slam poetry. Smith went in search of new tongues/ new languages, new seakings about normal, new texts that can Re-present. (Van Hove & De Schauwer, 73, in 17, 2021)

Finally, we also very much look up to Steven Taylor for holding a mirror up to our field in his foundational text (23): Before it had a name: exploring the Historical Roots of Disability Studies in Education. In this text, he describes, among other things, the effects of labelling and stigma and their relationship with the expansion of institutions and circuits of special education. He also discusses the precursor of the term 'ableism' namely 'handicapism' to point out the danger of systematic discrimination against persons with disabilities. Finally, Taylor also nicely demonstrates how these first theoretical concepts have paved the way to move away from looking only at person-centered 'deficits' to also being mindful of ...the social and cultural contexts in which disability is constructed.... (23, xix)

3.2.3. Rosemarie Garland Thomson.

The website of her home institution Emory University[17] introduces Garland Thomson as follows: ...Rosemarie Garland Thomson is a disability justice and culture thought leader, bioethicist, teacher, and humanities scholar. Her 2016 editorial, "Becoming Disabled," was the inaugural article in the ongoing weekly series in the *New York Times* about disability by people living with disabilities. She is an emerita professor at Emory University where she taught English, Disability Studies, American literature and culture, and feminist theory. Her work develops the field of critical disability studies in the health humanities to bring forward disability access, inclusion, and identity to a broad range of institutions and communities.

[17] http://english.emory.edu/home/people/bios/garland-thomson-rosemarie.html

For the Ghent Research Group on Disability Studies, Garland Thomson is of great importance and this because of two important contributions. Het work concerning 'staring' (24), for instance, gives us a completely new perspective on the phenomenon of 'staring' and 'being stared at'. A lot of people with 'extraordinary bodies' appear to deal with being stared at. Garland Thomson manages to stop describing this staring as just negative and disturbing. She shows that 'looking at' is a very natural response of people in response to unexpected or salient stimuli. Staring and being stared at initiates a relationship between people, relationship that can be continued with very different strategies. With her concept of 'beholding', she brings a new facet to the discussion of staring and being stared at... Whether we are viewing human suffering or terrible human beauty, intense looking is a good thing when it promotes attentive identification between viewer and viewed; it is a bad thing when it satisfies salacious curiosity or leads us into the ethical cul de sac of "schadenfreude". We might conclude then that ethical staring is a matter of beholding, of an arrested stare transforming into identification instead of differentiation. In other words, staring might be reconceived as a visual manifestation of the Winnicottian 'holding function'. The radical besiegement of both starer and staree in such an intense visual encounter holds an unexpected opportunity for mutual transformation... With her concept of 'beholding', she points to the potentially warm interest of those who look for those who are stared at. It offers attention that the stared upon needs as initiation for a relationship; it offers the stared upon assurance that people are interested in them.

Secondly, Garland Thomson is also of great interest because she has made a very clear connection between Disability Studies and the Feminist Paradigm. She does this because she sees the phenomenon of disability coinciding with the major concerns of feminist theorizing:... (25, 1559) Disability proves to be an especially useful critical category in three particular concerns of current feminist theory. First is probing identity; second is theorising intersectionality; third is investigating embodiment...

Garland Thomson (25,1558-1559) offers a serious option to include disability as a category within intersectional thinking. She does this by talking about 'a feminist disability studies' (FDS). FDS offers opportunities – given the long feminist struggle – to understand disability as a difference that often risks stigmatisation. It also helps to pay attention to communities of people with disabilities. FDS pays particular attention to

discriminatory attitudes and practices towards people with disabilities. Moreover, FDS also pays special attention to power differentials as they develop towards people with disabilities. FDS – and this is fully in line with Disability Studies per se – is going to be much less interested in separate diagnoses or target groups, much more concerned with exclusionary practices and the direct consequences that certain people experience as well as the question of who/what is normal? (Taken further: what characteristics must someone meet to be a 'human being'?) FDS is also very interested in the language used to talk about disability. In fact, a lot of language hides a lot of discrimination. Permanent negative writing and speaking about people also ends up leading to a representation that permanently provokes feelings of pity or negativity. In this sense, FDS is also very concerned with cultural practices.

Where in the first feminist wave (26, 27), the focus within Disability Studies was on an analysis of who took care of children with disabilities within families; then Garland Thomson and colleagues brought to attention a much richer and broader range of issues. It became clear that Disability Studies had a lot to learn from colleagues departing from the feminist angle.

3.2.4. Eva Feder Kittay

She is introduced as follows on info sites[18]: she is an American Philosopher. She is a Distinguished Emerita Professor at Stony Brook University (USA). Her primary interests include feminist philosophy, ethics, social and political theory, metaphors, and the application of these disciplines to Disability Studies.

In her work, Kittay has always paid close attention to the relationships between people who must live with great power differences. (But who are also interdependent from each other) She also continuously searches for the link between her philosophical thinking and real life. Finally, she has increasingly put the situation of people with (severe) intellectual disabilities at the center of her work. Indeed, she assumes that people who must live so dependent and are so surrounded by caregivers and care can be an important source of inspiration for Ethics of Care and Disability Studies.

[18] https://evafederkittay.com/
https://en.wikipedia.org/wiki/Eva_Kittay
https://www.zorgethiek.nu/tag/eva-feder-kittay/

In her first book of importance to Disability Studies, “Love’s Labor Essays on Women, Equality and Dependency” (28), Kittay looks at the situation of women who take much care of their children with severe disabilities. She starts from the thesis that in our society, we think mainly in terms of autonomous and independent citizens and that our socio-political system is not well adapted for situations where autonomy and independence are replaced by lifelong care dependency. From her own experiences with a daughter with high care dependency, she manages to show ...how theory and policy fail women when they miss the centrality of dependency to issues of justice. ...

If in her first book she mainly deals with the many care work that mothers do, work for which they are not recognized, the book ‘Learning from my daughter’ (29) mainly looks for another translation of Rawls’s theory. From a recent chapter (30) on this, the following can be deduced – this is described razor-sharp in the abstract belonging to the chapter -: ...She argues that, in conceiving justice in terms of voluntary associations between equals, Rawls neglects the reality of human dependence and interdependence. Kittay argues that there are five areas where Rawls’ conception of equality is inadequate for addressing dependency. We share here four of these five areas. Rawls mistakenly accepts the assumption that citizens are all “fully cooperating” members of society. The theory of justice mistakenly presumes that people are free in the sense that they are a “self-originating” source of valid claims. The chapter also argues that Rawls’s list of primary goods is not adequate for meeting the needs of those giving and receiving care. Finally, Rawls begins with a concept of social cooperation that presumes equality between those who cooperate. The chapter argues that with each of these assumptions, important concerns about dependency are omitted....

To give a ‘helping compass’ to the turnaround from ‘exchange between independent persons to care ethics and dependent persons’, Kittay introduces the concept of ‘flourishing’. Flourishing (31) is seen by Kittay as a very important human need. Every person has needs and desires that are important to him or her and they should be able to be fulfilled[19]. Putting this concept at the center as a notion for the way we care for each other and for the respect we could have for interdependence means listening from

[19] Kittay describes it (30, p.19) as follows: ... an ethics of care is especially fruitful in thinking how one can flourish REGARDLESS of ability or level of dependency....

connection to what someone really cares about and looking for how we can meet it: "...The lessons my daughter has taught me can be summed up in the appreciation for our ability to give, receive and share care and love, and in our acceptance of the rich diversity of human capacities..." (30, p.24)

- The great importance Kittay attaches to 'the self as relational' (29, p.22) runs nicely parallel to the way we at Ghent do not want to narrow the human rights narrative for people with disabilities to a technical-legal discussion alone. We too see 'the others' as "...embodied, relational and enculturated human beings..." (29, p.23) In doing so, we fully follow Kittay when she states that ".... A theory of justice that is fully inclusive would determine not just the fair terms of social cooperation among those who can be cooperators. It would consider the facts of inevitable human dependency and inextricable interdependency....
- In addition, Kittay offers us insight into the political nature of 'care work': (29, p.3) .... one of the demands of motherhood is to socialize one's child so that the child can grow into an adult that is accepted by her community as Ruddick describes...But when one has a child like my daughter, the demand is to socialize the community to accept her as an individual worth of moral parity with all human beings..." Care must be at the centre of our morality and our politics...

3.2.5. Subini Annamma.

On the Stanford website[20] , we read the following bio on Prof.Dr. Annamma:...Prior

to her doctoral studies, Subini Annamma was a special education teacher in both public schools and youth prisons. Currently, she is an Associate Professor in the Graduate School of Education at Stanford University. Her research critically examines the ways students are criminalised and resist that criminalisation through the mutually constitutive nature of racism and ableism, how they interlock with other marginalising oppressions, and how these intersections impact youth education trajectories in urban schools and youth prisons. Further, she positions students as knowledge generators, exploring how their narratives can inform teacher and special education....

[20] https://ed.stanford.edu/faculty/subini

Annamma, together with colleagues (32) such as David Connor and Beth Ferri, went in search of explanations as to why so many children and young people 'of color' ended up in special schools or juvenile detention centers. In addition, these authors charged that little research on 'non-middle-class', 'non-white' issues within Disability Studies stood out.

A very clear observation on the phenomenon was provided by Alicia Broderick's son. (33, p. 60)

"...When my (Broderick) son Nicky was in second grade, a close friend, Jamal, kept getting 'lunch detention'. Nicky wanted to sit with Jamal at lunchtime, so every time he got a detention, Nicky would try to get one by doing exactly what Jamal had done, but he would only get a reprimand. At first he was mystified by this phenomenon, so for two weeks he kept data on a scrap of paper in his desk: Jamal throws a paper airplane, he gets a detention; I throw a paper airplane, I am told to pick it up and to put it in the trash and go back to my seat. Jamal doesn't turn in his homework, he gets a detention; I don't turn in my homework, I am reminded to do it tonight and bring it in tomorrow. After two weeks of this, Nicky told me he had finally figured out how you get a detention in school. Apparently, he said, "You have to do one of the things of the list and have a brown skin. Mama my skin's the wrong colour he cried. 'I'll never get a detention'..."

In the DisCrit framework (the interplay of Disability Studies and Critical Race Studies), they start from the following seven propositions and positions (33, 19-26):

1. DisCrit focuses on ways that the forces of racism and ableism circulate interdependently, often in neutralised and invisible ways, to uphold notions of normalcy.

2. DisCrit values multidimensional identities and troubles singular notions of identity such as race or dis/ability or class or gender or sexuality, and so on.

3. DisCrit emphasises the social constructions of race and ability and yet recognises the material and psychological impacts of being labelled as raced or dis/abled, which sets one outside of the western cultural norms.

4. DisCrit privileges voices of marginalised populations, traditionally not acknowledged within research.

5. DisCrit considers legal and historical aspects of dis/ability and race and how both have been used separately and together to deny the rights of some citizens.

6. DisCrit recognises whiteness and Ability as Property and that gains for people labelled with dis/abilities have largely been made as the result of interest convergence of white, middle-class citizens.

7. DisCrit requires activism and supports all forms of resistance

These colleagues are looking for a deeper analysis of complex social problems. They adopt an intersectional approach where 'race' and 'ability' are read as phenomena that often interact and allow us to better understand situations of power difference and oppression.

From history, DisCrit is a logical (but late) response to the historical links between 'race' and 'disability'. It has long been the case that European school systems e.g. (33, p. 52) have used concepts such as 'educational subnormality' to exclude certain groups of children (in Gillborn et. al's case, 'Black British Students') from mainstream education streams. These authors analyse situations of Black British families and conclude that it is best to stop blaming teachers as if they embody permanent racism. They note that the malaise is historical and has much more structural than personal-particular components. They point out the dangers of diverting many of these children (33, p.53-54) to special schools. There, they get a curriculum less in tune with the challenges of society anyway, there they are often singled out on the basis of pseudo-objectified labels and enrolled, in a history of a group of children who are 'less able', 'less deserving' and ultimately 'less human'... (33, p.54) would be.

Ferri et.al, (33, p. 221) finally bring fundamental insights that might help to ensure that intersectionality is not narrowed down to a sum of multiple mechanisms of oppression: "...Our motivation in first wanting to articulate DisCrit was fueled by what we see as the need to continue to work towards a truly intersectional starting point of our collective work – refusing primacy of either race or disability or gender or any other aspect of identity without failing to acknowledge that schooling as an institution has been deeply invested in creating and maintaining hierarchies based on race, class and gender. We wanted to consider what new insights might emerge if our analyses BEGAN with the assumption that these or other systems of oppression are mutually constituted and interconnected at the deepest and most fundamental level.

3.3. Finally, we will also try to capture the small history of Disability Studies through describing some of the local and international events that have helped to make a difference.

3.3.1. The social model.

A very important 'movement' (turn) in trying to understand the phenomenon of disability is the one from the medical/individual model to the social model. The social model is historically linked to the organization UPIAS, the Union of Physically Impaired Against Segregation, and from their archives[21] we learn the following:

...Many disabled people with an interest in history will remember that UPIAS published a booklet called, Fundamental Principles, which set out a debate in a meeting between UPIAS and the Disability Alliance in 1975. It was in this booklet that the social definition of disability was formally explained. The social definition of disability was a radically new foundation for disabled people's understanding of discrimination and how to fight it. The phrase the social model which is used today came a few years later from Professor Mike Oliver, in 1983.

The model was developed by British sociologists led by Mike Oliver (most of them were impaired themselves) and is considered by many to be the beginning of Disability Studies. This turn is of such great importance that we do not fail to interpret and discuss it as a very important event for our field of research.

Indeed, British colleagues came to oppose that view which held that 'disability' could be understood as a personal tragedy. This old view was attacked mainly because it considered exclusion and discrimination normal, so to speak. The focus shifted to the context/environment and people moved to a structural analysis based on a neo-Marxist view. The social model adherents no longer saw the individual as the cause of problems, they saw the problems starting much more from the structures, the institutions that society had created.

[21] (https://tonybaldwinson.files.wordpress.com/2019/09/2019-upias-research-notes-tony-baldwinson-isbn-9781913148010.pdf)

A sharp distinction was made by this group between 'impairment' (the individual disorder) and 'disability' (the social structural problems that excluded people with impairment from participation as full citizens).

The discourse of the 'social model' was able to inspire, unite and mobilize people. It was also spread internationally around the world through the world of Non-Governmental Organizations. The model is at the basis of many actions to promote (physical) accessibility, and many people with disabilities tell us that it had an 'exculpatory effect' on them: they felt they were no longer the sole cause of participation problems.

That the Ghent Disability Research Group has not chosen the social model as the basis for Disability Studies has to do with three questions that can be raised. One is whether the great (only) emphasis on structures may not be a reason for denying the body. We can also ask whether (physical) accessibility eliminates all problems (e.g., attitudes of people – e.g., representation of persons with disabilities). Finally, we think the 'struggle model' should sometimes be able to alternate with an emphasis on relationships and allies instead of constantly pointing the finger at those who are wrong.

3.3.2. The Arduin Foundation: experiencing deinstitutionalization from the front row.

In 1994, we were asked if we – with the help of students – wanted to carry out a small study in Zeeland (the Netherlands). Stichting Vijvervreugd was under heavy pressure and interim manager Piet Van den Beemt and his new management team asked for an external second opinion. We agreed, not knowing what adventure we would be thrown into.

For Ghent University everything started with 12 courageous students of special needs education who went to observe the institutional grounds of Vijvervreugd for three days in January 1995. These observations together with consultations with staff members and the inventory and analysis of statistical data led us to conclude (34) that... we could only talk about the well-being of 22% of the residents with peace of mind. More than 40% were in the risk zone; more than 35% were receiving care that could be described as 'inadequate' or 'poor'.... We advised the organization to take in-depth decisions and to do so at the level of infrastructure, human resources, care planning, communication, and of coordination. We did not yet use the word 'deinstitutionalize' in this Report but spoke of 'decentral-

ization' (although in the case of infrastructure, we did refer to the fact that '...the current buildings have contributed to an impasse. They have become a symbol to be sacrificed...')

Our Report hit like a bomb, the Dutch government intervened and Stichting Vijvervreugd lost responsibility over the care for people with intellectual disabilities at the old site. The Arduin Foundation was set up and Piet Van den Beemt was appointed manager. Van den Beemt assembled a very small (but substantively strong) management team around him and from then on started making drastic changes based on the question: would I want my child/my brother or sister to live here?

Arduin became a symbol of renewal, many visitors came to watch and listen. Many discussions and conflicts passed (worried/critical parents – worried/critical unions), but Van den Beemt and his team went about deinstitutionalizing. Residents went to live in society and became citizens. Clients of Arduin stopped going to activities and went to work. Children with disabilities who were seen as not able to attend school were included into in local schools, ... Many houses and cottages were bought, employees were given different job contents, the care idea was replaced by the support paradigm.

This entire turnaround was closely monitored among others through Jos Van Loon's PhD (35). Van Loon conducted action research that allowed him to propose necessary improvement processes for this large-scale deinstitutionalization.

In the follow-up to this doctorate, a very fruitful collaboration arose in a triangle: Arduin – University College Ghent – Ghent University. Schalock, one of the leading figures of the AAIDD[22] found in Arduin a delightful playground for his research on Quality of Life of people with disabilities in society as well as the functioning of the support paradigm[23] (Schalock's colleague recently deceased Prof Dr Jim Thomson great advocate for the support paradigm joined in).

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22 AAIDD = American Association on Intellectual and Developmental Disabilities

23 Since 1992, the AAIDD (then AAMR) had advocated the "support paradigm". This paradigm assumed that people with disabilities had strengths and talents in addition to "deficits and problems" – that people with disabilities best lived and worked in ordinary environments – that people with disabilities were entitled to those supports that could help them participate in society – that people with disabilities needed to be supported not only through specialised services, but also by their natural network and by services accessible to all.

Arduin Foundation developed as an example of deinstitutionalization between 1995 and Piet Van den Beemt's retirement. Ghent students got lecture by Prof Dr Jos Van Loon, who became a visiting professor. Many were able to do internships at Arduin, while others were given the opportunity to do master's thesis research there. An honest collaboration with great respect for each other's qualities was established between Arduin and our Department. The whole deinstitutionalization process yielded great insights for the fledgling Disability Studies field at Ghent University, the research on deinstitutionalization and Quality of Life provided the necessary evidence that dismissed the accusation of being merely 'ideological'.

And yet..... after Piet Van den Beemt's retirement, his successors failed to maintain this course. In a fascinating essay[24] using Arduin as a case study, Hans Kröber and Willem De Gooyer write the following:

... In achieving inclusion, one of the success and failure factors is the socio-political environment. In 2015, the Social Support Act will be introduced. The Law aims to be a 'participation law'. A success factor, you might say. But the law also brings uncertainties. Working with tenders, new indications schemes and a tighter budget (for transport and housing, among other things) for municipalities pose a challenge. It demands vision, leadership, creativity and 'strategic operation' from care providers to keep operating on a small scale and 'in and with society'. After Piet van den Beemt's departure, Arduin fails to anticipate the new developments sufficiently. Concerns about continuity arise and Arduin's Supervisory Board intervenes. It appoints an interim director who is tasked with shaping a multi-year policy that considers the changed circumstances.

When the interim manager takes office in 2014, Arduin is not yet writing red figures, after that losses increase. In 2019, a negative result of 5.5 million euro's is recorded. The financial standards set by the bank are no longer met. The poor financial situation puts pressure on the quality of services. One part of Arduin, is placed under increased supervision by the Healthcare Inspectorate. Downfall looms. As in 1996, another institution is saved from collapse with support from the government and the care office. This time it is not Vijvervreugd but Arduin. Whereas in the 1990s the institution paradigm gave way – with government support – to the support paradigm, now the opposite is happening. The government is supporting

[24] https://www.socialevraagstukken.nl/rubrieken/essay/de-gehandicaptenzorg-op-zn-retour/

the takeover of Arduin by 's Heeren Loo with its plans to create new institutes in Zeeland.

The more than 100 small-scale shelters for clients in Zeeland will give way to several large-scale locations. Partly for business reasons, people with mental disabilities will be concentrated in 'residential centers'. In addition to group living, day care and treatment facilities are planned. The residential centers will be located on the outskirts of the city with a 'fine green environment' as hinterland and with an emphasis on safety. The 'total institute', now in a new guise, is back on the scene..."

This history and particular experiences teach us that human rights for people with disabilities are not a sure thing. As soon as the slightest opportunity arises, society starts correcting and putting people back to places where 'ordinary citizens' are not bothered by them.

3.3.3. Disability Studies at Ghent University: from course unit to part of the diploma title.

With a whole group of researchers and staff at the Department of Special Needs Education, we have enjoyed a great deal of freedom since 2001-2002 (when the course unit 'Diversity and Inclusion in Pedagogical Work fields was taught for the first time) to make Disability Studies a part of the Pedagogical Sciences program[25]. After Diversity and Inclusion, the course units Disability Studies I (from 2002-2003) and Disability Studies II (from 2003-2004) joined the program.

In the transition from Candidature/llicence to Bachelor and Masters, Diversity and Inclusion became a subject for second Bachelor and Disability Studies a course unit for 1° Master. Several Disability Studies classes are also provided in first Bachelor and third Bachelor. Thus, a nice learning trajectory is drawn throughout the program. All this resulted in 2019-2020 in the new diploma title Master in Pedagogical Sciences, major: Clinical Special Needs Education & Disability Studies.

The subject Disability Studies is also included in the embedded Teacher Training program at the University and as an elective within the Interuniversity Master after Master Diversity and Gender and in the

[25] Some of these developments were also included in the conversation "from memory" with Lieven Bauwens of Child-Help, https://www.youtube.com/watch?v=aCgLWSIPmXI

Interuniversity Master after Master Global Health. With this, we may say that as far as training/education is concerned, the discipline is there and is being imparted to many students.

In an article in 2012, our team at that time laid down some important lines that are of great significance to this day and which we allowed to come together in a 'Pedagogy of Hope' as described by Paulo Freire (one of our inspirations) (36, p.46)

"...Freire (2004) describes hope as follows: "Hope is necessary but is not enough. Hope is an ontological need; it demands anchoring in practice. As an ontological need, hope needs practice in order to become historical concreteness. One of the tasks of the progressive educator, through a serious, correct political analysis, is to unveil opportunities for hope, no matter what the obstacles may be." (36, 2-3)

We describe the pedagogy of hope for our educational practices as a way of thinking and working in which:

- *Problems are defined differently. No longer are the impairments of the children we work with seen as the main problem or obstacle. Instead, within a process of "conscientization" (Freire, 2000), students learn to see and analyse obstacles in attitudes, school culture, the training of experts, and discriminatory practices.*
- *Solutions are defined differently. We introduce students to the idea that we do not need detached and objective professionals with standard solutions. Instead, we expect students to strive toward becoming companions, who support solutions that are built via dialogical action and reflection.*
- *Roles are defined differently. Children with labels and their families areno longer docile acceptors of "what is there" (Freire, 2004). Instead, problems are perceived as challenges to overcome. Students are challenged to act as allies with children, parents, and teachers to concretize the ultimate dream of children with labels and their parents: to participate in society..."*

Fully in line with the insights of the founding fathers and founding mothers of Disability Studies, we tried to motivate students to work on 'real challenges' in small groups, in addition to several intensive lessons where research and theoretical concepts are covered.

In doing so, they were allowed to "go wild", be creative, ... on condition that the highest demands of relational ethics[26] were taken seriously and that the pieces of work became 'serviceable' for the practices they worked with. Groups filmed the experiences of people with disabilities for the doctorate of Dr Tina Goethals[27] (38); interviews were conducted with fathers of children with disabilities – a missing voice in health care -; podcasts were made for the Potential[28] project in which Dr Inge Van de Putte was responsible for the development of the project; many students were involved in research projects for the non-profit organization Parents for Inclusion and the non-profit organization Our New Future (see elsewhere in this text); students were also involved in the years that our research group was allowed to cooperate structurally with the Expertise Center on Inclusive Higher Education (SIHO)[29] – together with students, training courses were developed on disability awareness; there was also close cooperation with designers based on the idea that Universal Design and Universal Design for Learning were and are of great significance for Disability Studies.

In addition to the rather traditional methods of collecting research data in/for practice with students, more and more attention has also been paid to a crossover between Disability Studies and the Arts. In their respective PhD trajectories, Dr Marieke Vandecasteele (39) and Dr Silke Daelman (40) took quite a few students into uncharted territory. Collages were made, photo series applied, Instagram walls built, stop motion movies realized, together with students, we discovered new ways of putting narratives of people with a label and their families on the map.

No opportunity was also missed to include 'the body' in the lessons. (See our reluctance to the 'social model' elsewhere in the text) Dr Inge Blockmans' PhD (41) offered many perspectives for this. Together with students, experts by experience and experts from the field (e.g., Sensoa and Aditi), she built a teaching package around the non-normative body, sexuality, and relationships. A topic previously missed by many students in our program.

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[26] We were fortunate to work with Dr Lien Claes for several years. Her research has been very influential in our focus on that relational ethics (37)

[27] Dr Tina Goethals took students through exercises to listen to people with disabilities in order to learn to assess their experiential expertise. With her website full of stories (http://sgkb.zondergrenzen.be/), Dr Goethals left something that Flanders and our Department can be really proud of.

[28] Https://potentialtoteach.be/

[29] Colleagues like Katrien de Munck, Meggie Verstichele, Karen Leyman and Leen Thienpondt were close to students from SIHO in support and coaching.

It was also always nice to be able to work closely with colleagues from other Universities and University Colleges in those student 'exercises'. Especially in the initial phase, we collaborated with Prof Patrick Devlieger (KUL) so it became clear that Disability Studies could not only have a place within Pedagogical Sciences but also within Anthropology, for example. Later, the ties with Disability Studies in the Netherlands were forged through cooperation with, among others, Dr Sofie Sergeant and her 'drawing lab', with Prof Dr Alice Schippers and Dr Jacqueline Kool the identity for Disability Studies in the Low Countries was sought together with students. A lot of consultation and exchange took place with the designers of the University College West Vlaanderen (including Dr Lieven Decouvreur); accessibility exercises were set up with colleagues from the school for architects in Ghent; there was a lot of cooperation with colleagues from the Cultural Studies department (Prof Kris Rutten) on the Cultural Studies – Disability Studies crossover; work was done with colleagues from the VUB and Howest to follow up the first cohort of children with cochlear implants and their families in function of the doctorate of Dr Sigrid Bosteels (42), in this way, students were provided with the latest insights about Deaf people and Deaf culture for a number of years, without losing sight of the impact of technology (CI); with colleagues from Social Work at Ghent University (including Prof. Dr. Griet Roets), work was done on the Interpretative Research Methods course and with colleagues from University College Ghent (Prof. Dr. Claudia Claes), close ties were forged in function of 'inclusion internships'.

Disability Studies, as you can see, is a tangle of temporary and permanent collaborations where one adagium is always paramount: Nothing about us without us.

3.3.4. Parents for Inclusion and Our New Future arise and become structural partners of the Disability Studies research group at Ghent University.

Disability Studies is seen as an area of research where research is strongly (co-)driven by activism. In an interesting article Pamela Block (43, p. 68-69) writes the following:

"...My research "occupies" disability by engaging disabled people from a particularly vulnerable category of citizenship: adults, particularly young adults, requiring constant technological intervention and 24-hour skilled nursing. Who occupies disability? Certainly, disabled people do, and yet there are other categories of scholars and clinicians who claim disability

expertise that sometimes supersedes or overshadows the authority of disabled people themselves. Such expertise is monetised through health or academic systems, "occupying disability" in ways that I seek to problematize. Those who claim disability expertise have power and resources that can potentially be of benefit to disabled people and groups..."

Disability Studies scholars do not simply enter alliances with experts by experience. It is not about a temporary project, some quick focus group or even worse: using people with experience expertise for a one-off testimony. No, they build slowly and over the long term on a cooperation from which different parties get equal input and equal 'added value'.

In Ghent, we have been building every day – since the last 20 years – a structural cooperation with two extraordinary organizations: the parents' association Parents for Inclusion and the self-advocacy movement Our New Future. Let them introduce themselves briefly.

Our New Future, the Flemish self-advocacy movement for people with disabilities is celebrating its 25th anniversary this year.

They describe their actions as follows on their website[30]:

Our New Future is a movement by and for people with intellectual disabilities.

Above all, we want our movement to show that we are people with our own potential.

We want to fight injustice and defend our human rights.

What is important within Our New Future?

- *We know very well what we are good at.*
- *We know very well what we are not good at.*
- *We ourselves ask for support from other people and from each other.*
- *We want to be seen as strong men and women*

In turn, Parents for Inclusion[31] describes itself as follows:

"... Parents for Inclusion is a **voluntary organization of, for and by parents** of children with special needs. We aim to support the right to an

30 https://www.ont.be/wie-zijn-we/
31 https://oudersvoorinclusie.be/

inclusive life by empowering and assisting parents in situations where they experience difficulties. Parents' experiences, questions and concerns guide the organization..."

Our cooperation with these organizations is based on a number of important principles, a few of which we would like to recall here

1. It does not come down to adopting the agenda of the organizations. They remain entities that set their own course, the Disability Studies research group and students of Pedagogical Sciences mainly putting themselves 'at the service' of the collaboration.

2. We have been writing since 2005 (44) about 'modest relations' (the small relationship) as the foundation of our collaboration. In doing so, we put (once again) the relational character of the phenomenon of disability at the center. This relational character inevitably entails that the dichotomy: objective/subjective no longer holds. Heshusius (playfully) drew attention to this old dichotomy (in: 44) as follows: *"...One evening my attention was drawn to my cat that was chasing her tail or chasing 'ghosts' as we call it in our family. I couldn't help seeing a similarity: both my cat and the literature how to manage and be in charge of one's subjectivity were trying to catch 'the uncatchable'... Neither subjectivity, nor a cat's tail exists as an independent entity..."*

3. Doing Disability Studies research with structural partners is no sinecure we wrote in 2005 (44, p.193), and we came up with the following set of recommendations that we see still stand today (we do rephrase some of the original elements from the text):

    - we will have to pay a lot of attention to the 'time' aspect when collaborating with activists in research and education. To let everyone really participate, we will often have to provide more time, we will have to organise more consultation moments and we will have to pay extra attention to quality time within collaborative relationships.

    - we have to be aware of the fact that authentic disability research projects do not always fit into programmes of traditional research funding bodies.

- radical reflexivity can take us to the darkest corners of our life history and experiences, relationally doing research in this way carries all the risks that engaging in human relations does.
- the dual role ally/researcher has always potential for colonisation and exploitation.
- confidentiality and informed consent become ongoing negotiations. Professional researchers and co-researchers reflexively need to consider and discuss power dynamics at every turn and constantly strive to balance the need to advance the social agenda of the projects and the need to protect one another from harm.
- this kind of work may challenge deeply held values and assumptions. Some audiences may get shocked.

3.3.5. In 2006, the United Nations adopted the UN Convention on Rights of Persons with Disabilities (UNCRPD). This legally binding text aims to give extra attention to the human rights of persons with disabilities. It is notable that this Convention also joins people with mental health problems and Deaf people.

Countries that ratify the Convention pledge to review their legislation against the articles contained in the Convention.

The Convention calls for special attention to women and children and people with disabilities in the South.

The Convention focuses on several aspects: respect for diversity between people – accessibility – full and effective participation – non-discrimination – equality of opportunities... (art. 3)

An overview of the articles in the Convention can be found on: https://humanrights.gov.au/our-work/disability-rights/overview-articles-convention-rights-persons-disabilities

Belgium (and Flanders) ratified the Convention back in 2009. This is an action that cannot be without consequences.

Thus, much work has already been done to break away from “silo thinking” and “silo working” as it used to be organized. For example, for a long time it seemed that only the Flemish Agency for Persons with Disabilities in Flanders was responsible for persons with disabilities. One has introduced

'handistreaming'[32]; actions consisting of connecting responsibilities horizontally (this was very well elaborated e.g., in a Federal Plan[33] Handicap)

Similarly, much work has already been done on understanding and applying the concept of "reasonable accommodation" as described in the Convention. (Including in employment and education). Let us briefly follow the UNIA's[34] interpretation of this very important concept: *"...A reasonable adjustment changes something about an environment, making it accessible to a person with a disability after all. Such an action neutralizes the effect of the unadapted environment faced by a person with a disability. When do we speak of a reasonable adjustment?*

It meets the needs of the person with disabilities.

It allows the person to work, learn, play sports, live equally with other people, ...

She allows activities or movements to take place as independently as possible.

It guarantees safety and respects the dignity of the person.

How do we know whether an adaptation is reasonable? This is assessed on the basis of cost, frequency and duration of use, organizational impact, impact on the person with a disability, impact on the environment, lack of equivalent alternatives, ..."

In Flanders, for instance, attempts were made to meet Article 24 on inclusive education by introducing the M-Decree. This decree wanted to regulate the right to enrolment, provide reasonable adjustments in education and introduce individually adapted curricula. The implementation of this Decree is proving difficult, and there are plans of replacing it.

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32 handistreaming means that each minister or secretary of state must pay special attention to the rights of persons with disabilities within the framework of his/her powers. Specifically, every minister or secretary of state must draw on the necessary resources, including his/her own budget, for his/her powers and projects with a view to the inclusion of persons with disabilities, in order to remove the barriers that prevent this public from participating in cultural, social and professional life on an equal footing with other citizens. (https://equal.brussels/nl/themas/handistreaming-wat-is-dat/)

33 https://handicap.belgium.be/docs/nl/federaal-plan-handicap-2021-2024.pdf

34 https://www.unia.be/nl/actiedomeinen/onderwijs/wat-zijn-redelijke-aanpassingen#:~:text=A%20reasonable%20adjustment%20changes%20something,Veerle%20studies%20for%20nursing.

Similarly (see later), Flanders tries to document the participation of persons with disabilities in society by collecting as much statistical material as possible. This is of great importance in the regular reporting that is expected.

3.3.6. The Disability in Education Conference took place in Ghent in 2010.

Disability Studies has many homes. One of the important fields of practice that Disability Studies focuses on is education and parenting. Many international colleagues therefore sought each other within Disability Studies in Education (DSE). In a very relevant article, David Connor (45) writes a piece of history of that DSE. To lay a 'starting point' somewhere, many within DSE go back to our colleague Linda Ware who in ...1999 hosted a small international conference funded by the Spencer Foundation to challenge the ways that ideology explicitly and implicitly shaped inclusive education practices and to broaden the critical special education discursive community informed by international scholars of disability.

Some months later, Scot Danforth was able to bring together an unlikely panel at the national conference of TASH (The Association for Severely Handicapped) in Chicago under the name of Coalition for Open Inquiry in Special Education (COISE). The session was titled "Ways of Constructing Lives and Disabilities: The Case for Open Inquiry." His co-presenters included Lous Heshusius, Ellen Brantlinger, Chris Kliewer, and Phil Ferguson. People somewhat familiar with the older Disability Studies in Education literature will recognize the names of the founding fathers and mothers of critical thinking about special education here. The panel participants focused on what they called 'open inquiry'. Indeed, people were looking for other ways of doing research and for ways of reporting on this research. People clearly allowed the discussion to start from 'moving against' what they called the positivist paradigm. Connor describes what assumptions and consequences, according to these panelists, accompany research from this angle...:

- disability is a primarily bio-physical phenomenon consisting of a deficit condition existing within an individual.
- service professionals know better than persons with disabilities and family members what is best for a served individual.
- diagnosed or labelled individuals should be separated from the mainstream population for purposes of treatment. ...

The panel explicitly sought research methodologies and practices that would allow many voices to speak and could be put alongside the lineage outlined earlier.

Connor further reports on the actions taken by Susan Gabel to make DSE a recognized field of studies with international embedding. At the same time, Susan Gabel and Linda Ware informed those assembled that she had already applied with Disability Studies to American Educational Research Association to form a Special Interest Group (SIG), which was approved, and subsequently met for the first time in 2000. Since then, the discipline of Disabilities Studies in Education (DSE) has steadily grown from its "informal" beginnings. The following year, DSE launched its inaugural conference in Chicago hosted by National Louis University. Below, we list the specific conferences that have gone ahead. From 2018 onwards DSE has (again) joined the AERA Conferences where they have raised their profile as a Special Interest Group also within the Conferences.

- **2001** *Disability Studies and Education: Critical Reflections on the Themes of Policy, Practice, and Theory,* National-Louis University, Chicago, IL.
- **2002** *Education, Social Action, and the Politics of Disability,* National-Louis University, Chicago, IL.
- **2003** *Traversing the Chasm between Disability Studies and Special Education,* National-Louis University, Chicago, IL.
- **2004** *Reforming, Restructuring, Resisting in Special Education,* The Professional Development and Research Institute on Blindness at Louisiana Tech University, Ruston, LA.
- **2005** *The 30th Anniversary of the Individuals with Disabilities Education Act and its Impact on American Society,* Teachers College, Columbia University, New York, NY.
- **2006** *Disability Studies and Inclusive Education: Negotiating Tensions and Integrating Research, Policy, and Practice,* Michigan State University, East Lansing, MI.
- **2007** *Disability Studies and Inclusive Education: Implications for Practice?* National-Louis University, Chicago, IL.

- **2008** *Mitigating Exclusion: Building Alliances towards Inclusive Education Reform in Pedagogy and Policy,* Teachers College, Columbia University, New York City, NY.
- **2009** *Righting Education Wrongs: Disability Studies in Education Policy and Law,* Syracuse University, Syracuse, NY.
- **2010** *From "Handicapped Family" to "Partners in Policy": Disability Studies in Education and the Dialogue with Families and Natural Networks,* Ghent University, Belgium.
- **2011** *Rethinking Accessibility for the Next Decade of DSE,* National-Louis University, Chicago.
- **2012** *Contemplating Disability Studies in Education Throughout Life: In School and Beyond*, Hunter College, City University of New York, NY.
- **2013** *(Re)Imagining and (Re)Building Education for All*, University of Christchurch, New Zealand.
- **2014** *Learning from the Past. Ensuring the Future*, University of Victoria, Melbourne, Australia.
- **2015**, Disability Studies In Education: What It Is, Who Decides, and Why It Matters – Annual Second City DSE Conference National Louis University in Chicago
- **2016** Second City Disability Studies in Education Annual Conference/ Midwest Summer Institute, Des Moines
- **2017** The Seventeenth Disability Studies in Education Conference University of Minnesota, Mineapolis. (Looking at disability studies from three intersecting perspectives: Inclusion, Universal Design for Learning, and American Indian education).

It was a great honor for the Ghent Disability Studies group to host this group of colleagues in our city in 2010 after eight USA-bound conferences. Consistent with our structural cooperation with Parents for Inclusion, we also made partnership with parents a conference theme. In many sessions, explicit attention was paid to the knowledge parents can bring to the discussion tables with professionals. In line with our choice of the 'support paradigm' (see events around Arduin in this text), the sources of support that parents can often bring were also discussed as an important research

theme. We are convinced that the DSE Conferences have greatly contributed to the professional development of, among others, Kathleen Mortier (46), Elisabeth De Schauwer (47) and Inge Van de Putte (48) as once young Ghent researchers who all later successfully completed a doctoral program. To this day, these colleagues are experts in the field of Inclusive Education and all three – Mortier as a professor in Calfornia; De Schauwer as a professor in Ghent and Van de Putte in a combined job at Ghent University and in inclusion practices – are considered leading voices in the inclusion debate.

3.3.7. The first overview report (49) on 'the social position and participation of persons with disabilities'.

Flanders has had Ministers for Equal Opportunities in governments since 1995. (Sometimes this responsibility is also called "Integration" in certain legislatures) The administration that has to assist these Ministers has built up great expertise over the years, which is of great importance to Disability Studies. It was therefore an important learning opportunity to work with the colleagues of the administration for many years. Topics such as: accessibility, Universal Design, Human Rights for people with disabilities, are at the forefront of that Administration's work. They also played a major role in building and developing GRIP[35] , NOOZO[36] , Parents for Inclusion and Our New Future, among others.

In the follow-up to the UN Convention (see elsewhere in the text), a first Statistics Report was recently published. – countries and states that have ratified the Convention are expected to collect 'hard data' that can outline the situation of this country vis-à-vis the articles in the Convention -. With this, Flanders breaks with the long-standing trend where it was always said that no data was available and therefore the situation of persons with disabilities could not be discussed. In addition, the erroneous silo effect – for people with disabilities only the Flemish Agency for persons with a Handicap[37] applies – is broken through and, fully in line with the UN Convention, a cross-link is made between different domains (and thus policy responsibilities) in society.

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35 GRIP, https://www.gripvzw.be/, describes itself as a human rights organisation of/for people with disabilities

36 NOOZO, https://www.noozo.be/nl/, is the Flemish Advisory Council for and by people with disabilities

37 For the Flemish Agency for Persons with Disabilities, see: https://www.vaph.be/

The first Report does not show such a pretty picture. We briefly summarize (49, p.3):

"...Overall, it can be said that the social position and participation of persons with disabilities is clearly inferior to that of persons without disabilities. Persons with disabilities are generally less highly educated, participate less in the labor market, are more often confronted with lower incomes and a higher risk of poverty, more often live in a less stable and qualitative housing situation, experience health problems much more often and participate less in club life, culture, sports and politics. In almost all domains, it also appears that people with disabilities who experience severe impairment in their daily activities score even worse than those with limited impairment.

Complementing these general findings, this report highlights some important blind spots in the available data on the target group. The sources fail to fully capture the totality and diversity of

the group of citizens with disabilities. (Read: little or no data are available on people staying in residential facilities because these people are not included in Flemish surveys needed to map their social participation). In addition, data are lacking on various domains that play an important role for people with disabilities in really being able to participate fully in social life. To eliminate these blind spots, specific additional efforts are needed..."

Recent discussions about the (in)visibility of persons with disabilities in the media (as a result of the television program 'Down the Road'); the questions raised in addressing the COVID situation with regard to persons with disabilities; the flood of press releases about the M-Decree; the discussions about the long waiting lists for support, the research data on increased chances of sexual abuse of women with disabilities (50); as well as the reports released by UNIA[38] year after year about discrimination based on 'disability' (in 2020, 564 Dutch-language reports of discrimination were received., A figure that parallels reports in 2017, 2018 and 2019) continue to show that attention to Human Rights and 'Equal Opportunities' is and remains at least as important as attention to care and treatment.

[38] https://www.unia.be/nl, until recently UNIA as the Interfederal Equal Opportunities Centre, an independent public institution fighting discrimination and promoting equal opportunities in Belgium, was the place to report discrimination. (Recently, a Flemish Human Rights Institute was established)

Through years of cooperation with the Equal Opportunities Department, the Disability Studies research group at Ghent University has learned a lot (but has also been able to contribute) about how Disability Studies insights can support the necessary development of new policies with and for people with disabilities.

4. A preliminary conclusion.

In Ghent, Disability Studies is organized within the Pedagogical Sciences and that is something I – especially after writing the above text – very much support. After all, the Pedagogical Sciences offer Disability Studies the opportunity of the 'Pedagogical Utopia' as well as the 'Pedagogical Relationship'.

4.1. Disability Studies and the Pedagogical Utopia.

Pedagogical Utopia was recently highlighted strongly in an article (under review) by my colleague Hanne Vandenbussche (51). She draws on the work of Ernst Bloch. Bloch's ideas provide support for thinking about multiple futures. Until recently, the lives of many people with disabilities were mainly organized via fixed 'care pathways'. (studying in special education – working in a protected work environment – living in a sheltered housing environment). Dreams, different alternatives, open futures, were not an immediate issue for people with disabilities. Disability Studies is partly at the basis (via working together on follow-up pathways to inclusive education) in letting go of these rigid predetermined pathways and moving towards a practice of multiple/open future(s). Bloch's insights come in very handy here: …According to Bloch the future is neither the outcome of historical necessity, nor simply the temporal succession of disaggregated events, but it is in the end result of a 'labouring, creating' process in which we work with the contingent reality we find to bring about a new and better world. This better world both exists and doesn't exist at the same time. It exists in a conscious or unconscious form in our dreams and desires as well as in pre-illuminations of utopia in our everyday lives, but it also does not exist other than as a yet unimaginable other...

So for Bloch, Utopia already exists ...it is all around us in what he calls pre-illuminations of a better world. It is, becomes concrete because its existence is only an as-yet impossible potentiality. (52, p.46)

Disability Studies that, among other things, relies on a human rights framework and works on the elimination of discrimination against citizens with disabilities is thus in great need of a framework that puts forward 'Concrete Utopias' and can support small and large acts of resistance and activism of people with disabilities and their families. In such a framework, dreams become a worthy alternative to the rigid trajectories previously relied upon. Moir (53, p. 58) links Bloch's thinking on dreams (the non-bourgeois dreamer) to the thesis that meaning that the material world is utopian insofar as it is not yet 'there' or complete but in a process of desire-driven becoming.

4.2. Disability Studies and relationships.

Working with people's dreams, collaborating on concrete utopias coincides with the need to build a (pedagogical) relationship that attaches a lot of importance to 'listening'. In thinking about and trying to apply this listening, we fall back on two giantesses of Pedagogy, namely Carlina Rinaldi and Bronwyn Davies. Rinaldi literally speaks of a "Pedagogy of Listening" (54, especially. pp. xxiv, xxvi) ... it exemplifies for us an ethics of an encounter built on welcoming and hospitality of the Other – an openness to the difference of the Other, to the becoming of the Other. In practice, it includes listening without preconceived ideas of what is correct or appropriate.... and ... welcoming the stranger, which means an affirmation, a *yes, yes, yes*...to the Other, the stranger.... Here Rinaldi makes a direct connection to the thoughts elaborated by Jacques Derrida (55) in his thinking on "l'Hospitalité".

It is striking how closely this discourse resonates with the work of Bronwyn Davies, an Australian colleague we have been allowed to learn from for about a decade (56,57,58,59,60,61,62) and who greatly inspires us. On pages 14-15 of one of her books (63), she takes us through a wonderful account of an encounter with a little boy in Sweden. Something beautiful develops between two people who are very different in age, language and position" ...in his openness to my difference, he is able to create a space in which he can speak with animation and with joy. Together we sit down

to explore the intricacies of a picture he loves. He draws my attention to particular details, looking at my face to see if I am attending, then telling me more, laughing as he does so. He draws me into his world and the world of the book. Because I can't speak Swedish, I can't obey any impulse I might have to re-territorialize the space with teacherly striations in which I direct, and he follows. Like the boy I also discover new possibilities. I find myself listening to the sounds of his voice, reading his body language and his facial expressions, opening myself up to his idea, his pleasure.... Our difference from each other, in particular our language difference, far from being a problem, was an asset in opening us up to what we could each become in relation to the other..."

If Disability Studies wants to search for dreams together with people with disabilities and their families, these forms of listening as a basis for a pedagogical relationship will be necessary. Malaguzzi (Rinaldi's teacher) encouraged us to pay attention to 'the hundred voices (of children)'. Bronwyn Davies motivates us (63, p.81) to listen in such a way that an AND rather than an OR emerges. In doing so, she aligns herself closely with Deleuze who invites us to dare to see the least perceptible of things. That can be found in a listening driven by AND, looking for the in between..... a line of flight of flow.

This is how people in relationships become less fixed and assigned to binary categories. This is the listening that Disability Studies in Ghent tries to stand for.

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Laudatio Joris De Langhe

Marijn Speeckaert

This afternoon, I feel honored and delighted to deliver this laudation for the award of the Sarton Medal to Prof. Dr. Joris Delanghe for his outstanding work, publications, research, and education in the field of clinical chemistry. In a laudation, one traditionally describes the quality of the work, its origin, the motivation, and the person hidden within the researcher. We want to do this by elaborating on some symbolic aspects and data that I will now share with you.

Joris Delanghe was born in Zelzate on July 22, 1957. After completing his secondary education at the Sint-Amandusinstituut in Ghent, he studied medicine at Ghent University, where he obtained a medical degree in 1982. In 1987, he obtained his doctorate in biomedical sciences, with great distinction. After his recognition as a physician specialist in clinical biology, he obtained a higher education aggregation in clinical biology in 1989. His appointment as Clinic Head at the Clinical Biology Laboratory of Ghent University Hospital was followed by an appointment as a part-time lecturer in Clinical Chemistry attached to the Department of Clinical Biology, Microbiology and Immunology of Ghent University in 1994. After several successive promotions, Prof. Delanghe was appointed full professor of clinical biology in 2017 and became a department chair.

However, what justifies the selection of Prof. Joris Delanghe for the Sarton Medal, in my opinion, is not only his merit as a full professor but also his impressive track record in research. As many of you know, Prof. Delanghe is a renowned expert in the field of clinical chemistry. He is a dedicated academic with a strong interest in multiple research domains, such as urine analysis, research into plasma proteins and their polymorphisms (e.g., haptoglobin, complement C3, vitamin D binding protein, etc.), and in recent

years, glycation and studying enzymes involved in glycation. His research has always been innovative, resulting in him publishing more than >550 peer-reviewed A1 articles and accumulating thousands of citations. With an H-index of 70, he established himself as a leading voice in the field and has made a significant contribution to our understanding of clinical chemistry. All of this led him to rank 169th among the top researchers in Belgium in the field of medicine.

Prof. Delanghe is highly regarded for his dedication to mentoring and supporting the next generation of clinical chemists. He is a natural-born teacher and enthusiastically taught in various programs throughout his career (including medicine, pharmaceutical sciences, and biomedical sciences) as well as to residents in training (including the rational use of clinical biology in the MaNaMa training of hospital physicians). He was also a Block Commission Chair and later the titular holder of the "Diagnostic and therapeutic techniques" block in the medical education program. He has also been involved in various educational assignments abroad, including in Rwanda, China, South Africa, and Palestine, and has introduced new diagnostic techniques, for example, for detecting diabetes mellitus in developing countries.

Prof. Delanghe passed on his passion for research to many young researchers, ensuring their growth and success. This has resulted in the successful defenses of more than 25 national and international Ph.D. candidates. I can only confirm that I was infected by him, not by COVID-19, but also by his passion for research.

I could continue for a while, but the time allotted to me did not allow it. In my opinion, there is no doubt. It is for all these reasons that I have just listed, and many more than that, that we are honored today to award Prof. Joris Delanghe the Sarton Medal.

The history of scurvy and vitamin C deficiency.

Joris R. Delanghe

1. An ancient story

Scurvy is one of the genetic metabolic anomalies that has been with us since prehistory, as it was already reported by the Egyptians (1550 BC) and Hippocrates (460 BC – 380 BC) (Hirsch 1885; Carpenter 1986). Scurvy presumably originated with the advent of agriculture. The introduction of an agrarian lifestyle allowed to store large quantities of cereals during winters. In consequence, human migration towards moderate climate zones became possible due to an improved food supplementation during longer winters. Stored grain however only contains small quantities of vitamin C. Therefore, it can be assumed in prehistorical times, populations developed scurvy at the end of long winters because of their grain-rich diet.

The first description of scurvy can be found in the Ebers papyrus in Egypt (a medical papyrus of herbal knowledge) about 1500 BC (but believed to have been copied from earlier texts). The Ebers papyrus not only described the condition, but even described scurvy patients could be treated with onions, an easily accessible vitamin C source.

Also in Old Greece scurvy episodes have been described. Hippocrates described that scurvy patients presented with bad "bad breath, loosening gums, and nasal bleeding." In contrast to the Egyptians, the treatment proposed by Hippocrates was probably ineffective since the condition required "a difficult treatment often accompanying the patient to death". Apart from Hippocrates, there are only scanty documentation of scurvy and its treatment in the antiquity. James Lind (1716 - 1794) mentions that old Greek, Roman, and Arabian authors and scientists hardly mention scurvy.

2. Northern Europe

The old-Norse tradition already knew that some plants (leek, angelica, cabbage) could prevent scorbut. These plants were raised in kitchen gardens. Theft of these plants was punished in old Norse laws. In Northern Norway scurvy was prevalent among recent migrants. Laps and Sami used wild plants, scurvy grass (Cochlearia officinalis), and cabbage. These plants and wild berries, were collected during summer and conserved them during winter. It was common knowledge that scurvy could be prevented and treated with various kinds of plants (De Luca 2011).

3. The Middle Ages

Between the Hippocrates era and the 16th century, little is published about scurvy. Scurvy was probably present in Northern Europe in the centuries preceding the Age of Sail. James Lind (1716 - 1794) commented on the possibly etymology of the word scurvy in his Treatise on Scurvy. Lind believed that the word scurvy was derived from one of four Northern European languages. A first possibility is the Danish word "schorbect" meaning oral ulcers. A second possibility is the Dutch word "shcorbeck" with the same meaning. Furthermore, the Saxon word "schorbok" which refers to the tearing of the stomach/abdomen is a possible etymology. Finally the Slavic word "scorb" (this explanation was preferred by Lind because of its occurence during the long winters in Russia and the Baltic. Based on Lind's text and the occurrence of possibly related terms in a number of North European languages, It is likely that the disease was prevalent in N. Europe from the earliest settlement to the Age of Sail.

The Crusades left a written text dealing with scurvy during the 13th century. During Lent, when soldiers ate no meat (except eel) and restricted their diet, a scurvy epidemic broke out: "the barber surgeons were obliged to remove the necrotic tissue from the gums in order to allow the patient to chew their food " The Crusaders believed that the disease was caused by the eating of eel.

4. Medieval China

During the Ming dynasty (1368 - 1644), China started to explore the worlds and organised huge well prepared expeditions, reaching the Eastern coasts of Africa (Torck 2009). Admiral Zheng He (1371 - 1433) commanded an extreme diverse fleet which even included garden ships (where vegetables and orange trees were growing on the ship deck). The Chinese are well aware of scurvy (which they called "sea bad blood disease") and do not risk to go far into the ocean but prefer to sail along the coast lines. Remarkably, the maritime expeditions were discontinued after 1430, partly because of political reasons.

5. Spain

According to old legends, during one of the expeditions led by Columbus, a number of Portugese sailors, severely affected by scurvy, asked to be abandoned on an island rather than dying aboard the ship. On the island they ate vitamin C rich fruits and they recovered. On the way back to Europe, Columbus and his crew saw that people from the island were waving to them. They appeared to be the same sailors who had been abandoned because of scurvy and had recovered from the disease; from then onward, the island was called "Curacao" (cure)

6. Scurvy theories in the Renaissance

In 1596 Henrik Høyer brought berries and plants to the famous botanist Carolus Clusius (1526 - 1609, Leiden). The correspondence between Høyer and Clusius is enclosed in Botanics, published in Antwerp in 1601. Clusius described the plant Chamaemorus norvegicus. The description of the plant and its use is relevant to understand the early attempts of scurvy prevention: in a letter by Henrik Høyer to D. Petrus Pauwius (1564 -1617), professor in anatomy and botany at the Academy of Leiden, it can be concluded that in Scandinavia a berry can be found resembling Chamaemorus. End 1593 he sent conserved fruit as well as branches and leaves. The letter by Høyer further describes that this plant grows in wet and humid places, and that it is called Molteberren by the local population. He described

how every year this fruit was used by the local population in Norway and Finnmark to produce jam (De Luca 2011).

According to the theory of four humours, black bile causes depression and fatigue. This body fluid was controlled by the spleen. As a logical consequence, a Dutchman John Echth concluded in the 16e century that an excess of black bile and an obstruction of the spleen caused scurvy.

According to Peter Stark in Last Breath: The Limits of Adventure, an expedition in the interior of Maine, a chronicle attributed 36 out of 80 deadly victims during the trip to "gross, cold and melancholy meats" in the 1600's. Although the gross meats could not have helped the men's nutrition, raw seal meat kept Innuits well-nourished in similar climates, the meat was not solely to blame. Another prominent doctor in the early 18th century, Richard Mead (1673 – 1754), believed that poorly ventilated ships were the cause of scurvy. This poor ventilation definitely was unhealthy but did not cause scurvy.

7. The Age of Sail

Scurvy never was prominently present or problematic in Europe until the time that naval technology allowed to make long voyages overseas. Technological progress, combined with the ambition to explore created in Europe the necessary conditions to turn scurvy into the plague of the seas. In 1497, Vasco da Gama (1460 - 1524) left Portugal with 160 sailors to discover a searoute to East India around Cape of Good Hope. Out of the 160 sailors, 100 died from scurvy during the voyage. The Expedition of da Gama's resulted in the first description of "sea scurvy". The Portuguese Luis de Camões (ca. 1524 - 1580), soldier and poet celebrating the voyage of da Gama, wrote the poem "The Lusiad" dealing with the scurvy victims.

Scurvy caused the death of more than two million sailors between the time of Columbus's expeditions and the rise of steam powered vessels in the mid-19th century. Scurvy was so common that governments and shipowners took into account a 50% death rate among sailors from scurvy on any long voyage at sea. In the 1500s and 1600s several ship captains suggested there might be a connection between fruits and vegetables and scurvy. In 1734 the Polish – Dutch physician Johannes Bachstrom (1688 - 1742) coined in 1734 in his book "*Observationes circa scorbutum"* the term *antiscorbutic* ("without

scurvy") and used it to describe fresh vegetables. He was the first person known to suggest that scurvy might be a deficiency disease. Unfortunately, at the urging of Jesuits, presumably for his liberal opinions on religion, he was imprisoned and killed in Nieswiez in 1742. The success of the Dutch East Indies company (Verenigde Oostindische Compagnie, VOC) can be partly attributed to the constructions of the gardens in Cape Town, which could provide fresh fruit and vegetables to VOC crews passing by.

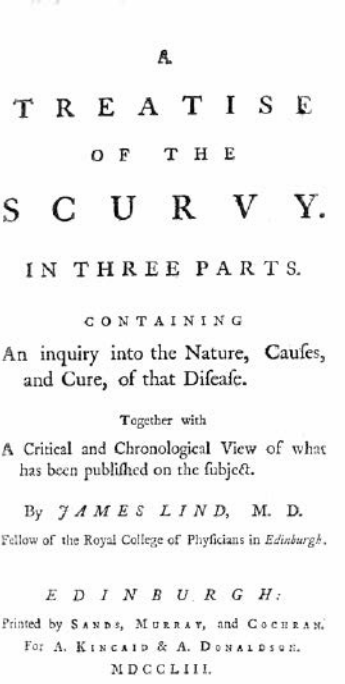
8. James Lind (1716 - 1794)

The Scottish doctor James Lind was a pioneer of naval hygiene. By conducting one of the first ever clinical trials, he proved that citrus fruits cured scurvy. By 1747 he had become surgeon of HMS *Salisbury*, and conducted his famous experiment on scurvy while that ship was patrolling the Bay of Biscay. In 1740 the catastrophic result of Commodore George Anson's circumnavigation attracted much attention; 1400 out of 1900 men died, most of them from scurvy. Scurvy caused more deaths in the British fleets than French and Spanish arms. Since the 17th century in England, it had been known that citrus fruit had an antiscorbutic effect, but their use did not become widespread. Although Lind was not the first to suggest citrus as a cure for scurvy, he was the first to study its effect by a systematic experiment in 1747. It was the first reported, controlled, clinical experiment in history, particularly because of its use of control groups. Lind thought that scurvy was due to putrefaction of the body that could be neutralized by acids, so he included an acidic dietary supplement in the experiment after two months at sea when the ship was afflicted with scurvy. He divided twelve scorbutic sailors into six groups of two. They all received the same diet but, in addition, group one was given a quart of cider daily, group two twenty-five drops of elixir of vitriol, group three six spoonfuls of vinegar, group four half a pint of seawater, group five two oranges and one lemon, and the last group a spicy paste plus a drink of barley water. The treatment of group five stopped after six days when they ran out of fruit, but by that time one sailor was fit for duty while the other had almost recovered. Apart from that, only group one showed any effect from its treatment.

In 1753, he published *A treatise of the scurvy*, which was mostly ignored. When James Cook went on his first voyage he carried wort, sauerkraut and

a syrup, or "rob", of oranges and lemons as antiscorbutics; but, only the results of the trials on wort were published. In 1762 Lind's Essay on the most effectual means of preserving the health of seamen appeared. In it he recommended growing salad—i.e. watercress on wet blankets. This was put into practice, and in 1775 the British Army in North America was supplied with mustard and cress seeds. However Lind, believed that scurvy came from ill-digested and putrefying food within the body, bad water, excessive work, and living in a damp atmosphere. While he recognized the benefits of citrus fruit, he never advocated citrus juice as a single solution. He believed that scurvy had multiple causes which therefore required multiple remedies.

The medical establishment continued to believe that scurvy was a disease of putrefaction, curable by the administration of elixir of vitriol, infusions of wort and other remedies designed to 'ginger up' the system. In the Navy however, experience had convinced many officers and surgeons that citrus juices provided the answer to scurvy, even if the reason was unknown. On the insistence of senior officers, led by Rear Admiral Alan Gardner (1742 -1809) in 1794, lemon juice was issued on board the HMS Suffolk on a voyage to India. The daily ration of two-thirds of an ounce mixed in grog contained just about the minimum daily intake of 10 mg vitamin C. There was no serious outbreak of scurvy. This resulted in widespread demand for lemon juice. The following year, the Admiralty accepted the Board's recommendation that lemon juice be issued routinely to the whole fleet. This was not the end of scurvy in the Navy, as lemon juice was at first in such short supply that it could only be used in home waters under the direction of surgeons, rather than as a preventative. Only after 1800 did the supply increase so that, at the insistence of Admiral Lord St Vincent, it began to be issued generally.



A

TREATISE

OF THE

SCURVY.

IN THREE PARTS.

CONTAINING

An inquiry into the Nature, Cauſes, and Cure, of that Diſeaſe.

Together with

A Critical and Chronological View of what has been publiſhed on the ſubject.

By *JAMES LIND*, M. D.

Fellow of the Royal College of Phyſicians in *Edinburgh*.

EDINBURGH:

Printed by SANDS, MURRAY, and COCHRAN.

For A. KINCAID & A. DONALDSON.

MDCCLIII.

9. Gilbert Blane

Physician to the Fleet (1779 – 1783), Gilbert Blane (1749 - 1834) did much to improve the health of sailors by improving their diet and enforcing proper sanitary precautions. Despite Lind's publication, on the importance of fresh fruit and vegetables in preventing scurvy, the Admiralty had not implemented his recommendations, and scurvy remained a significant cause of sickness in the Fleet.

After the proof by James Lind that lemons could cure scurvy, it took another 4 decades to resolve the inconsistencies in the results leading to the authorization by the Admiralty of a daily allowance of lemon juice to the British Navy.

Blane published a pamphlet entitled On the most effective means for preserving the health of seamen, particularly in the Royal Navy. He advocated the use of citrus juice as a preventative and cure for scurvy and eventually, as Commissioner of the Sick and Wounded Board, persuaded the Admiralty to go against the theories of the medical establishment and introduce lemon juice as daily addition to the naval diet in 1795. Later lemons were replaced by limes which could be obtained from Britain's Caribbean colonies. He was a founder member of the Royal Society in 1784. In 1795 Blane was appointed as Commissioner on the Sick and Wounded Board of the Admiralty; the provision of soap, lemons, adequate ventilation and standardized medical stores have been attributed to his reforms.

By the middle of the 19th century, advances in technology were reducing the need for any kind of scurvy preventative. Steam power had shortened travel times considerably from the age of sail, so that it was rare for sailors to be months at sea without fresh food. Citrus juice was a legal requirement on all British vessels by 1867, but in practical terms it was becoming superfluous.

So when the Admiralty began to replace lemon juice with an ineffective substitute in 1860, it took a long time for anyone to notice. In 1860, naval authorities switched procurement from Mediterranean lemons to West Indian limes. The motives for this were mainly colonial. Confusion in naming didn't help matters. Both "lemon" and "lime" were in use as a collective term for citrus, and though European lemons and sour limes are quite different fruits, their Latin names (citrus medica, var. limonica and citrus medica, var. acida) suggested that they were as closely related as green and

red apples. Moreover, as there was a general belief that the antiscorbutic properties of lemons were due to their acidity, it made sense that the more acidic Caribbean limes would be even better at fighting the disease.

In this, the Navy was deceived. Tests on animals would later show that fresh lime juice has a quarter of the scurvy-fighting power of fresh lemon juice. And the lime juice being served to sailors was not fresh, but had spent long periods of time in settling tanks open to the air, and had been pumped through copper tubing. A 1918 animal experiment using representative samples of lime juice from the navy and merchant marine showed that the 'preventative' often lacked any antiscorbutic power at all.

In the mean time, production of lime juice had switched to a Victorian industrial plant, in which copper tubes were used. At this time, people did not realize that the copper largely destroyed the vitamin C during the manufacturing. Vice-admiral George Nares (1831 - 1915) who led the British Arctic Expedition in 1875 discovered this fact. The expedition was a catastrophe. Two men in the sledging party developed scurvy within days of leaving the ship. Within five weeks, half the men were sick, and they were barely able to make it back. A rescue party sent to intercept them found that lime juice failed to have its effect. Even some of the men who stayed on the ship, never failing to take their daily dose, also got scurvy. The failure of the Nares expedition provoked an uproar in Britain. The Royal Navy believed itself capable of sustaining any crew for years without signs of scurvy, yet here was an adequately supplied crew crippled by scurvy within weeks. For the first time since the eighteenth century, the effectiveness of citrus juice as an absolute preventative was in doubt. Even the British Antarctica expedition led by Captain Scott failed because of scurvy: the diet of the expedition did not contain vitamin C sources! More evidence came at the turn of the century, during the Jackson-Harmsworth Expedition to Franz-Josef Land in 1894.

In 1893, a Norwegian expedition led by Fridtjof Nansen (1861 - 1930) could stay in the Arctic for more than 2 years without fresh food and without lime juice supplements.

This pattern of fresh meat preventing scurvy would be a consistent one in Arctic exploration. It defied the common understanding of scurvy as a deficiency in vegetable matter. Somehow men could live for years on a meat-only diet and remain healthy, provided that the meat was fresh.

Though scurvy was always associated with a lack of greens, fresh meat contains adequate amounts of vitamin C, with particularly high concentrations in the organ meats that explorers considered a delicacy.

10. Scientific discoveries

The Norwegian professor Axel Holst (1860 - 1931) carried out research in collaboration with Theodor Frølich (1870 - 1947), professor Pediatrics. Holst and Frølich suspected a nutritional deficiency for scurvy in the Norwegian fishing fleet, "shipboard beri - beri," which was considered as a variant of beri - beri. Holst and Frølich constructed an animal model which allowed the study of dietary factors, as well as de preventive value of products.

Replacing pigeons (a beriberi research model) by guinea pigs as a laboratory animal was a lucky strike: the guinea pig later appeared to be one of the few species which could develop scurvy, whereas pigeons, (seeds eating birds), could synthesize their own vitamin C in the liver and cannot develop scurvy. Scurvy originated in guinea pigs on a diet consisting of multiple grains, symptoms were prevented with antiscorbutics (fresh cabbage, lemon juice).

The findings were published in 1907 in the Journal of Hygiene, but were not well received by the scientific community: the concept of nutritional deficiency was still unknown (the word "vitamin" was only coined in 1912 by the Polish - American biochemist Casimir Funk (1884 -1967)). In the work that led to the isolation of vitamin C as antiscorbutic factor in 1932 - 1933, the model of Holst and Frølich was of primordial importance for the identification of the ascorbutic vitamin (hexuronic acid, later called ascorbic acid). Harriette Chick (1875 - 1977) used the guinea pig model to carry out vitamin C research

The Hungarian researcher Albert Szent-Györgyi (1893 - 1986) and his research fellow Joseph Svirbely found that "hexuronic acid" was actually the unidentified antiscorbutic factor, known as vitamin C (Svirbely 1932). After Haworth had determined the structure of vitamin C, and in honour of its antiscorbutic properties, it was given the formal chemical name of L-ascorbic acid. In some experiments paprika was used as the source for their vitamin C.

In 1933 Walter Norman Haworth (1883 - 1950, Birmingham University) determined the molecular structure of vitamin C. In the same year, Reichstein (working in Zürich) independently succeeded in synthesizing vitamin C in what is now called the Reichstein process (Nature, July 11, 1933) (Reichstein 1933). A combination of chemical synthesis and biotechnology was used for the first time to convert D - sorbitol into L - sorbose, an unusual solution for that time.

In 1937, two Nobel prizes were awarded to vitamin C - related research, which nicely illustrates the importance that was given to these discoveries. In 1937 Szent-Györyi (Szeged University, Hungary) received the Nobel Prize in Physiology or Medicine "for his discoveries in connection with the biological combustion process with special reference to vitamin C. Walter Norman Haworth was awarded the Nobel Prize in Chemistry 1937 for his investigations on carbohydrates and vitamin C. The in vitro synthesis of ascorbic acid by Tadeus Reichstein was not awarded with the Nobel Prize (Reichstein received the prestigious award for his pioneering work on for discoveries relating to the hormones of the adrenal cortex, their structure and biological effects")

11. Newer insights on vitamin C resulation

Although scurvy is generally classified as a nutritional disorder or avitaminosis, the view of vitamin C deficiency as a pure nutritional problem needs to be updated: The vitamin C status is not only determined by diet but also by the environment, lifestyle, biological (e.g. inflammation, iron overload) and pathological conditions (e.g. malabsorption, hemolysis) (Langlois 2009; Pincemail 2011; Lowik 1993; Galan 2005; Vioque 2007; Johnston 2006). Based on the results of modern large-scaled epidemiological surveys, correlation between vitamin C intake and vitamin C concentration is rather weak ($r = 0.42$). Only ± 17% of the variance of the serum vitamin C concentration can be explained by vitamin C intake (Hampl 2004). Several in vivo factors related to inflammation and oxidative stress have been demonstrated to influence the biological variation in vitamin C concentration (Langlois 2001). Genetic polymorphisms coding for vitamin C transporter protein (SVCT) 1 (SLC23A1 gene) (Cahill and El-Sohemy 2009) and glutathione S-transferase (GST) (Cahill 2009) may affect the concentrations of fasting serum ascorbic acid independent of diet. SVCT1

and SVCT2 genotypes modify the strength of the correlation between dietary vitamin C and serum ascorbic acid (Cahill and El-Sohemy 2009). GST enzymes have a protective capacity against vitamin C deficiency when dietary vitamin C is insufficient (Cahill and EL-Sohemy 2009).

Furthermore, the acute phase protein haptoglobin (Hp) is characterized by a genetic polymorphism with three phenotypes (Hp 1–1, Hp 2–1, and Hp 2–2). The major biological function of Hp is binding and recycling of free hemoglobin (Hb) in plasma to prevent oxidative damage induced by heme iron following hemolysis (Langlois and Delanghe 1996). When the Hb-binding capacity of Hp is saturated, its antioxidant role is taken over by hemopexin (heme-binding protein) and by vitamin C. The stability of vitamin C depends on the iron status and the Hp polymorphism. This finding has important consequences in a historical perspective since Success of long-range human migration has been strongly determined by Hp polymorphism. Due to natural selection, some populations characterized by high Hp 1 allele frequencies are much less prone to scurvy (Torck 2009). The recommended dietary allowance (RDA) values of vitamin C might be strongly Hp phenotype dependent.

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Laudatio Marcus Clauss

Geert P. J. Janssens

At the end of 2021, a call for the Sarton medal circulated in the Faculty of Veterinary Medicine. The history of science is not typically a domain that receives much attention at our faculty. Yet, leaning back, I realised that I knew someone that would fit in perfectly. Marcus Clauss and I must know each other for about a quarter of a century, and throughout these years, he regularly sparked me with philosophical considerations that went beyond our particular field of research.

He for instance published a critical evaluation of the Harvard versus Vancouver referencing style, emphasizing his strive to identify best choices for scientific progress. Basically, the major part of his work in animal nutrition and digestive physiology breathes evolution but also history. He has often revisited old studies, always with constructive criticism and in respect of pioneering work. Author guidelines can be found that urge or even oblige authors to only use recent literature. Marcus will likely agree with me that such directives are actually harmful for scientific progress.

Who is Marcus? He graduated as a veterinarian at the Ludwig Maximillian University in Munich in 1997. His early passion for wildlife already showed through his internships at different zoos and wildlife institutions. He was awarded a DAAD scholarship to go to London for the Master in Wild Animal Health, which he obtained in 1998. Already in 1999, the year after his graduation, his first paper on wild animal nutrition was published (i.e., on copper deficiency in yak). After his studies in London, he moved to Berlin as research assistant at the Institute for Zoo and Wildlife Research (IZW) under director Reinhold Hofmann. The latter is particularly known for his work on the browser-grazer dichotomy, to which Marcus Clauss has made substantial additions. In 2000, he got a position as research assistant

at the Institute of Animal Physiology, Physiological Chemistry and Animal Nutrition in Munich, where he continued his work on comparative digestive physiology and nutrition but was also part of the Bavarian BSE Risk Assessment Group, after which he became a certified veterinary specialist in animal nutrition and dietetics. One year later he passed the exam for diplomate in the European College of Veterinary and Comparative Nutrition, and again one year later, he obtained his habilitation degree. He started at his present institute in 2005, where he was recruited as senior research associate at the Division of Zoo Animals, Exotic Pets and Wildlife of the Vetsuisse Faculty in Zurich. Since 2013, he is professor *ad personam* for Digestive Physiology, Nutrition and Biology of Wild Animals, Exotic Pets and Wildlife at the same institute. We are honoured to have him as visiting professor at our group.

With a father that is renowned for his dedication to ancient epigraphic data collection, it cannot be a surprise that Marcus Clauss inherited an interest to dig into literature data. He developed a talent to distil laws of nature from comparative data analysis. People that know Marcus Clauss will confirm his bright mind. Yet, it is mainly his deontology that renders him my respect as a scientist – I am trying not to use superlative since he does not like them. Although deontology may have a strict meaning as defined by Kant, I here refer to his ability to independently navigate and communicate in science business, maintaining high ethical standards. Similar to his understanding of evolution, he can pinpoint the events in life science history that have challenged genuine progress in science. Such challenges include the lingering publication pressure, with the seductions by an increasing number of publishers with mainly/only commercial aims, but also the subtle impact of societal opinions on how and which science should be done and communicated.

A seemingly minor thing that marks him as a conscious and integer scientist is the fact that he never does anonymous reviews for journals. This has nothing to do with ego but rather shows a personal statement that he has nothing to hide and wishes an open, fearless and unbiased debate, irrespective of the involved parties (including friends). This example also reflects his dislike of old boys networks and other phenomena that endanger critical thinking and productive decision making in science. On this topic, I recommend reading his novel *Deborah's Secret*. His Sarton lecture will demonstrate how the lack of critical thought may lead to undeliber-

ate misconceptions, and has led to dominant convictions in science that hinders the necessary debate. He is the living proof of the importance our university's slogan "Dare to think" (*"Durf denken"*).

Our field of research, comparative nutrition, is inherently related to evolutionary biology. Comparative nutrition is a science that tries to understand why animal species select and process their diet the way they do. This comparative approach brings the advantage to take a distance from ruling dogmas that often exist within the research domains of one species' nutrition, including humans. Looking beyond the knowledge within a species almost automatically urges to lean back and become aware of historic and evolutionary perspectives. This is what Marcus brings in his lecture.

Historical (and psychological) aspects of zoological science: the power of words, the tenacity of both simple rules and exceptionalism, and how the belief in perfection – not in God – separates creationists from evolutionists

Marcus Clauss

Though we are trained natural scientists, we are subject to a vast sphere of un-scientific influence factors. Many of these factors have a historic and systematic component, being linked to anything from human psychology to research fashions. Being aware of such factors can be considered important for a sober evaluation of science, including one's own scholarship – while it may not automatically affect academic success. In this contribution, I will present a series of such factors that I have encountered during my career. The selection and sequence is somewhat arbitrary yet follows the outline of my Sarton lecture.

The words we use

The development of scientific narratives includes the use of individual words that function as labels, and of arguments composed of a limited number of sentences. The choice of specific words often triggers immediate associations. At the same time, a specific word or a rhetoric of limited sentences often precludes further association or reflection. Both can be critical in our understanding of scientific texts. An evident example would

be a hypothetical enzyme. Assume you detect an enzyme that degrades amylose (starch). You might call it 'amylase'. And from that moment on, when people read that name, they will think the function of this enzyme is to degrade amylose, and the possibility that this might be a side-effect of its original (completely different) function will mainly be lost to them. My personal collection of strange words includes not only the predictable 'punctuated equilibria' that characterise the fossil record (Eldredge and Gould 1972), but also the 'functional response' that characterises population reactions to resources (Holling 1966) as well as the reaction of individual herbivore food intake to food availability (Gross et al. 1993), or 'specific dynamic action' for the postprandial increase of metabolic intensity coined by Max Rubner (McCue 2006). For the study of digestive adaptations, other examples exist, such as the use of a physiological property like rumination for the phylogenetic label of the clade 'Ruminantia', which leads to the dilemma that other clades with the property, such as the camelids, are not considered 'ruminants' but called 'pseudo-ruminants' to maintain a phylogenetic separation, where in terms of the physiological property of having a regurgitation and re-mastication process linked to a sorting mechanism in the forestomach, there is no relevant distinction! Apart from the wrong impression of a functional difference invoked by the term 'pseudo-ruminant' when applied to camelids (Maloiy and Clemens 1980), the same term has been applied – basically indiscriminately – to rabbits (Walsh and O'Donovan 2020), hamsters (Williams and Taylor 1985), kangaroos (Sharman 1971), hippopotamus (Park et al. 2018), peccaries (Carl and Brown 1983), or even horses (Mutungwazi et al. 2022). The heuristic gain is nil. The attraction of using such terms seems to be great. A sentence like '*the camel is a pseudo-ruminant*' is devoid of meaning, yet will make the author seem privy to expert knowledge.

For the description of diet niches that originally only relate to botanical diet composition, such as 'grazer' and 'browser', we suggested that a conceptual, unjustified mingling of *botany* with *selectivity* led to the common terminology that search engines destined to bring you high-quality information are called 'browsers' (Clauss et al. 2010).[1] Whether abandoning the strictly botanical 'browser' (Hofmann and Stewart 1972) and the subsequent use of the term 'concentrate selector' for animals that eat mainly

[1] If that hypothesis could be corroborated, it could be an ironic example of how science influences daily life – by its un-scientific component.

browse by Hofmann (1973, 1988, 1989) is really responsible for this, I cannot tell. However, I have personally met opposition when suggesting that the zoo diets for browsing herbivores should include less concentrate feeds, with opponents insisting that one should evidently feed 'concentrates' to a 'concentrate selector'. There is scattered literature evidence that the so-called concentrate selectors appear to often suffer, in captivity, from conditions triggered by too much concentrates (Marholdt 1991; Clauss et al. 2003; Clauss and Dierenfeld 2008; Monson et al. 2018), suggesting a link between the choice of a specific, conceptual word and consequences this can have in real life.

In nutritional ecology, terms like 'frugivore', 'omnivore' or 'carnivore' may trigger associations of fruit and meat-based diets that have nothing to do, in terms of biochemical composition, with the diets actually consumed in the wild (Schwitzer et al. 2009). Consider that Ballari and Barrios-García (2014) document that wild boars consume 90% plant material and nevertheless call the species an 'omnivore' without any clarification. A classic example of how a label can lead to a misconception about diet is the case of lions, termed 'carnivores' (i.e., meat eaters), which develop rickets when fed only meat (Chesney and Hedberg 2010).[2]

The urge to not only use standard nomenclature, but to introduce drama and exaggerated relevance, can be nicely delineated starting from the 'carnivore' label. A traditional way of ascribing a species to the 'herbivore' or 'carnivore' trophic niche is if the species consumes >90% of either plant or animal material. Nevertheless, various authors from the 'carnivore scene' use the term 'hyper-carnivore' (ironically, this was at times defined as animals eating >70% meat) (Van Valkenburgh 1991; Holliday and Steppan 2004; Bestwick et al. 2022). Such a habit has several spinoffs: the herbivorous red panda is called a 'hypocarnivore', a term defined as 'eating mostly or only vegetation' (Wallace 2011). Herbivore researchers evidently did not want to fall behind in terms of drama and consequently introduced the term 'hyper-herbivory' (guess for what: animals that eat only plants!) (Wäber et al. 2013; McPhee and Choiniere 2016). The final folly then was to apply the 'hyper' prefix to the intermediate trophic level, invoking the niche of 'hyper-omnivory' (Bird et al. 2021). These words add no scientific meaning but habituate the readership to an unscientific use of labels.

[2] Note that the problem is the lack of bones and visceral organs characteristic of whole prey, not the lack of plant material.

In a seminal paper, Vinkers et al. (2015) demonstrated how in recent decades, the use of self-praising words like ‘amazing’, ‘encouraging’, ‘excellent’, ‘groundbreaking’, ‘innovative’, ‘promising’, ‘robust’, ‘unique’ or ‘unprecedented’ has dramatically increased in the scientific literature. Again, such words have no real scientific meaning – but they habituate the readership to the intuition that science is not really different from advertisement. Reading scientific texts soberly becomes an exercise in mentally blacking out these words to perceive the true content of the text (if there is one, one might add sarcastically). The number of scientific publications that tell the reader, e.g. at the end of the abstract, that the text provides ‘new insights’ on the topic mentioned in the title, has become staggering. Can anyone think of a better intelligence insult to the reader? If one believes that the intrinsic appeal of science is not that you can earn a living or become famous, but that you describe reality with precision, one would best let the language reflect that aim.

A craving for rules

Humans think in causations, and we want to link form with function. There are evident examples where form, however, is not optimized for function, but more parsimoniously explained by historical (evolutionary) contingency. Actually, that is why comparative anatomy is one of the cornerstones of evolutionary theory (Dawkins 2009).

My favourite example is the method of propulsion used by whale sharks and whales. Sharks use a horizontal side-stroke with a perpendicular tail fin, whales use a vertical down-stroke with a horizontal fluke. Which of the two is more efficient? I have not checked thoroughly, or performed biomechanical experiments, but believe there is no relevant difference. The difference is in the mode of movement in the respective ancestral lineages, with fish known for a horizontally undulating pattern, and terrestrial mammals in gallop for a pattern where the vertebral column contracts and expands in a horizontal plane (Buchholtz 1998). The movement patterns represent two different solutions to the same problem, none being superior.

Does digestive anatomy reflect the natural diet? Of course it does, you might say, because this is what we have been taught, and because this is the common sense default assumption (try wording the opposite). As Karasov

et al. (2011) put it: *"A dominant theme in digestive ecology is the correlation between the physiological and morphological features"*. Let us explore the narrative that digestive anatomy and physiology reflect the natural diet. Let us do that as an example of how refractory and stubborn we are when it comes to scientific truths, and how assumptions that apparently come naturally will persist even in the overwhelming presence of proof to the opposite. What is it you know about diets and guts?

Most likely the same I have been telling students for the better part of my teaching life: faunivores have simple, short, and not-so-voluminous guts, because the eat a highly digestible diet. Herbivores have complex, long, and voluminous guts, because their diets are not only less digestible, but also require more time to be digested, and digestion typically requires the presence of a symbiotic microbiome that needs to be housed in that gut.

Typically, teachers like me or Stevens and Hume (1995) or Karasov and Martínez del Rio (2007) or Withers et al. (2016) illustrate these statements with graphic representations of the digestive tract of an undisputed faunivore, like the domestic cat, and of an undisputed herbivore, like the domestic sheep. The difference is there, loud and clear – simple stomach, short intestine, in the faunivore; complex stomach, long intestine in the herbivore (Fig. 1). It is easy to see, and hence easy to understand and believe. But of course, as a scientifically educated person, you know that you must not believe a set of two pictures.[3]

What about using another set of examples? Dolphins are undisputed faunivores, they eat nothing but fish (or squid). They have complex stomachs, and very long intestines. Giant pandas are undisputed herbivores, they eat nothing but bamboo (a group of plants), and they have simple stomachs and shorter intestines (Fig. 1). So what now?

[3] Do you?

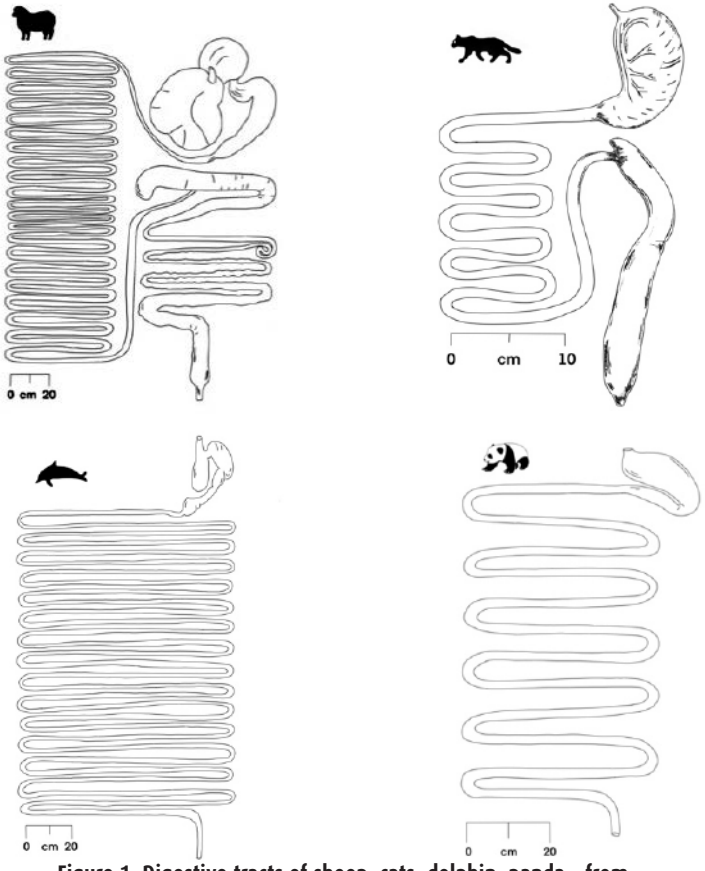

Figure 1. Digestive tracts of sheep, cats, dolphin, panda – from Duque-Correa et al. (2021). Drawings by Emilia Clauss.

What criterion will you use to judge that the first pair of graphs is representative of the faunivore-herbivore dichotomy, whereas the second pair of graphs represents a choice of outliers that are not truly representative? You might use the fact that the giant panda (and its not-so-closely related namesake, the red panda) are rare examples of herbivorous species from carnivoran groups that otherwise have produced faunivorous or omnivorous species. But dolphins are no exceptions – they belong to a speciose clade of faunivorous species, the cetaceans, that are all characterized by complex stomachs.

Let us work backwards and ask, what literature is our concept based on? You might name the fascinating monograph of Stevens and Hume (1995)

and their parallel review (Stevens and Hume 1998), in which they display a large set of famous graphs depicting digestive tracts. No quantitative evidence. You might name the very influential paper by Chivers and Hladik (1980), where not only a plethora of digestive tracts are given as illustrations, but where digestive tract measures are also submitted to statistical analyses. The overlap between diet groups is substantial, and various details of this work might lead to the conclusion that the methods are not robust.[4] What else? Neither Lavin et al. (2008) nor Smith et al. (2017) found statistical evidence for an influence of diet on the length of the small or large intestine in mammals, respectively. Neither in carnivores, ruminants nor in primates could a stringent effect of diet on intestine length be demonstrated (McGrosky et al. 2016; McGrosky et al. 2019a; McGrosky et al. 2019b). Across eutherian mammals, Langer and Clauss (2018) could not demonstrate a stringent relationship between diet and gastrointestinal complexity. But is this just a finding of the more recent literature?

Turning towards the older literature on the topic reviewed by Behmann (1973), a series of investigations did not produce evidence for a stringent difference in intestinal lengths between trophic categories (Holmgren 1944; Gorgas 1967); in particular, it was noted that

- among the Carnivora, the more carnivorous felids all have a caecum, whereas the more omnivorous ursids, including the herbivorous panda, do not have one;
- that among the Rodentia, the more omnivorous Gliridae do not have a caecum, in contrast to several carnivorous species;
- that among primates, Hill and Rewell (1948) could not establish a relationship between diet and the extent of the caecum.

Both Harder (1951) and Behmann (1973) cite Jacobshagen (e.g. 1937) to the effect that it is a vain effort to search for stringent relationships between diet and gut anatomy.

[4] There is a dramatic difference in measures between the sheep and the goat in the dataset, with sheep having less 'fermentation' capacity, tending towards the frugivores; the rabbit is placed on the borderline between frugivores and folivores; the golden cat and the domestic pig have similar measures on the border between faunivores and frugivores; dietary classifications are not consistent across the analyses, e.g. the group of colobine monkeys is classified as both frugi- and folivorous in one display (Fig. 18) and as only folivorous in another (Fig. 20); whether a surface area of a haustrated structure like the colon of a pig or horse or gorilla can be really approximated using 'length and a series of breadths' (p. 356) appears questionable.

What has changed since? How can we claim that *"digestive system design is in accord with the economy of nature"* (Karasov et al. 2011)? By talking a lot about about sheep and cats, omitting the whales and the muroid rodents, and by backing up a claim like *"herbivores tend to have more voluminous digestive tracts than do carnivores of the same size in mammals"* (Karasov et al. 2011) by citations (Stevens and Hume 1995; Karasov and Martínez del Rio 2007) that do not submit that hypothesis to a statistical analysis.[5]

What has surely *not* changed is our greed for rules. Science is supposed to deliver causal and functional explanations. Humans favour the simple ones, grudgingly accept more complex ones, but do not let go. When Cuvier (1799-1805) claimed that there is a correlation between different organs, such as between teeth and digestive tract, he struck a chord that still reverberates in us, regardless of Huxley's admonition that this is not necessarily so, and that various shapes can fulfil the same functions (Spencer 1857).

Arbitrary starting points

In any description of a biological phenomenon, one faces the question how to start the narrative. Is the phenomenon the general condition (and hence we assume it applies to all taxa or all situations) and outliers are the didactic focus that teach us something about this condition? Or is the phenomenon a peculiar adaptation that sets its possessors apart from the background of taxa that do not have it? In reality, we often do not decide this question proactively, but let the decision be imposed on us by the history of our area of science.

The widespread use of the word 'pseudo-ruminant' mentioned above is one example. Because humans have investigated ruminants, and in particular domestic ruminants, to an amazing degree of thoroughness (Van Soest 1994), we are so used to ruminant anatomy and physiology that we tend to compare anything to it, calling other foregut fermenters 'ruminant-like' (Moir et al. 1954; Moir 1965; Bauchop and Martucci 1968) or other herbivores with some common feature with ruminants – and be it only microbial fermentative digestion of plant material – 'pseudo-ruminant' (see above). We even may decide to describe all foregut-fermenting animals summa-

[5] This does not mean the claim cannot be substantiated, if one focusses on terrestrial species only and goes for 'common' species (Clauss et al. 2017; De Cuyper et al. 2020).

tively as ‘ruminants’ (Janis 1976). Such an approach does not convey the (correct) impression that it is microbial fermentative digestion that is rather the rule than the exception among extant mammals (Stevens and Hume 1998), and that the ruminant system may parsimoniously be interpreted as a series of physiological additions to the common layout that does not make most mammals ‘ruminant-like’, but that sets ruminants apart (Clauss et al. 2010; Clauss et al. 2015; Clauss et al. 2023). The ruminant digestive physiology is not widespread in terms of taxa – it is just widespread in being represented by a very speciose taxon, and in the form of domestic ruminant livestock being nearly ubiquitous.

Separation-mechanism based coprophagy (Björnhag and Snipes 1999) is a convenient example of the other way round, where a common condition is presented as an individual peculiarity of specific species. The human, disgust-driven reluctance to accept this strategy (Karasov and Martínez del Rio 2007) is mirrored in historical sequences of publications that first claimed a species did not practice coprophagy or considered it a pathology, then reported sporadic ‘normal’ observations, and finally accepted the strategy as part of the species’ general physiology, as exemplified in nutria (*Mycastor coypus*) (Kirner 1931; Otto 1954; Gosling 1979; Takahashi and Sakaguchi 1998, 2000), paca (*Cuniculus paca*) (Kraus et al. 1970; Matamoros 1982; Pérez 1992; Sabatini and Paranhos De Costa 2001; Guerra Aldrigui et al. 2018), capybara (*Hydrochoerus hydochoeris*) (Hirakawa 2001, 2002) or the gerbillinae (Otken and Scott 1984; Pei et al. 2001; Khokhlova et al. 2005). The more parsimonious approach is not used, i.e. that separation mechanism-based coprophagy is most likely part of the digestive physiology of all lagomorphs, hystricomorph rodents and muroid rodents (Clauss et al. 2007), and that only those species in which it was conclusively excluded are listed as not doing it.

Actually, the whimsical example of coprophagy resembles the much more momentous one of consciousness. Rather than adding, painstakingly and reluctantly, species after species to the list of animals in which consciousness was proven, one could also assume the stance of the Cambridge Declaration on Consciousness (Low et al. 2012) that all vertebrates have the morphophysiological prerequisites for consciousness, and only those in which it is conclusively disproven are listed as species that do not have it. Given this example, it becomes evident that the choice of starting point can be highly historical (here: humans assuming to be something special) and

highly political (here: assuming no consciousness for many animals facilitates a certain justification for using them). This can lead to the peculiar situation that research is being conducted on questions, like whether calves do better when being raised in groups (as opposed to the conventional way of raising them in single-keeping unit) (Costa et al. 2016) – as if this was something that required clarification. It would appear biologically more sound (yet potentially politically less convenient) to demand that the onus of proof is on those who want to keep calves in isolation – that this way of housing has no negative effect on their behaviour, cognition, performance and health. On a much smaller scale, but nevertheless of the same political relevance, one could ask why people investigate whether offering browse to giraffes kept in zoos has recognizable beneficial effects (Hatt et al. 2005); should the onus of evidence not rather lay on those people who intend to advocate that giraffes can be kept in zoos without browse?

Arbitrary end points

On the other extreme of the line of argument is when a conclusion is reached, rather than pursuing or discussing the consequences to the end. To me, the most captivating example is the so-called Jevons' paradox. Jevons (1866) observed that as machines were developed to be more efficient in their use of fuel (in his case, coal), the fuel was not saved on a national (or even global) level, but on the contrary, it was used more because the more efficient use meant more people could afford these machines. This effect still has not become part of what we teach our children about technology, and it has hardly entered political debates about progress. Many people accept a narrative that stops at making machinery more efficient. To evolutionary biologists, Jevons' observation is not paradoxical at all. It is a matter of course that once a more efficient organism evolves, it will replace the one preceding it in a niche – a process Rosenzweig and McCord (1991) call 'incumbent replacement'. But this does not mean that the new, more efficient species will use its efficiency to consume, at the same number of individuals as its predecessor species, less resources. Of course not. The idea alone would seem ridiculous. It will of course use the resources to the same extent (one might think of the concept of carrying capacity) to fuel more individuals. Applied to a renewable resource (such as primary production – plant material fuelled mainly by sunlight), the

increased efficiency hence has an effect that more individuals can live in the same ecosystem. Applied to a non-renewable resource (such as fossil fuels), the increased efficiency will simply accelerate depletion.

Teaching evolution while not believing it

An astonishing field of biological theory is that of life history trade-offs. Life history is often taught as a set of trade-offs (reviewed in Clauss et al. 2019) that sound like 'either a species invests a lot of resources into early reproduction (and dies at a relatively young age) or a species invests more into somatic maintenance and hence reproduces more slowly (yet lives for longer)'. Another way of putting it is assuming that per lifetime, animals are expected to endure the same number of heartbeats, breaths or chews (Peters 1983; Fortelius 1985), although that would mean that a bat would have to display an unbelievably slow heartbeat to keep itself from reaching the same number of lifetime heartbeats as a similar-sized dasyurid ('marsupial mouse') that does not reach a quarter of the bat's lifespan.

When conceptualizing life history in this way, where trade-offs determine the choices available to animals in terms of 'evolutionary solutions', the very basic concept of evolution itself is betrayed: that organisms may evolve means by which life history trade-offs may be changed (Rosenzweig and McCord 1991). Organisms might evolve, for example, so that they can have a faster growth at less reduction in reproductive investment – by becoming 'more efficient'. Ignoring or denying this possibility, by explicitly or implicitly fostering the assumption that trade-offs represent unchangeable physical laws, will restrict our understanding of evolution, and could be compared to

- claims that with a car and a given amount of fuel, you can either transport more load for a shorter distance, or less load for a longer distance, ignoring the possibility that someone might devise a more efficient engine that can transport a load longer, or a higher load for the same distance (Knittel 2011);
- claims that when feeding your chicken, you have to give more food for a longer period of time to produce more meat, ignoring the possibility that someone might breed a chicken line that grows faster with the same amount of food, or even with less food (Bennett et al. 2018);

- the concept that there always is a trade-off between reproduction and longevity, and that a measure integrating all individual life history components (such as 'lifetime reproductive effort') is constant across taxa, with variation mainly due to measurement error (Charnov et al. 2007), ignoring the possibility that 'high quality' individuals may reproduce more and live longer than their conspecifics (Mitteldorf 2010; Blacher et al. 2017; Ibler and Fischer 2017; Kuszewska et al. 2017; Schrempf et al. 2017; Tidière et al. 2017), and may pass on this trait to their offspring.

Taxa with different efficiencies in metabolic processes might evolve, and biological characteristics of extant taxa might therefore represent *snapshots in evolutionary time* rather than unveil fixed physical laws (Fritz et al. 2009; Pontzer and Kamilar 2009; Clauss et al. 2014).

Two ways of being a creationist

Christian creationists cherish creation because *'God saw that it was good'*, as repeatedly stated in the Bible's first book, Genesis. In my view, what evolutionary biologists do when developing narratives of *'perfect adaptation'* is similar:[6] they appeal to a sense of meaning we derive from quality and excellence. Take any nature documentary – how long can you watch and listen until you hear a sentence that some organism is *'perfectly adapted'* to an environment or specific situation? A biologist who claims that *'evolution led to a (specific) perfect adaptation'* does the same as a creationist who claims that *'God made something perfect'*. In both cases, it is the *perfection* that mainly appeals to us, not so much the agency. A narrative that *'evolution did a sloppy job so far and has not found a perfect solution yet'* is just as un-appealing as the story that *'God created some stuff of mediocre quality that is okay for some situations but surely not up to mastering tough challenges'*. Again, it is not the agency that grips us or repels us, it is the excellence, or the lack of it.

As scientists, it is our vocation to look for excellence. But not in the excellence of agency, not in the excellence of some material entity; rather, in the excellence of explanation. To put it bluntly: have a hard look at the world – can you trust any narrative, creationist or evolutionist, that claims something is 'perfect'? Have a look at any biological data in any biological paper. There are

[6] This view parallels the same expressed much earlier by Gould and Lewontin (1979).

patterns with a lot of scatter. There is no perfection, and not for a lack of precise measurements. Any narrative that invokes perfection most probably fails to excel as an explanation. But it sure catches the attention of human beings.

Questions that have not been asked

For my personal favourite question that has not been asked, I refer again to my favourite paper of mine (Clauss et al. 2019): how can a cattle produce the same output (an offspring of a certain maturity) as a horse in two months less time? How can a hare produce the same output within 40-odd days for which a hyrax requires seven months? Differences in gestation length are fascinating yet evidently follow patterns of 'organismal design' (i.e., taxonomy) rather than simple laws such as scaling with body mass (Clauss et al. 2014). But even though we have known about these differences for centuries – we have not come up with a concept of how these differences come to occur in the first place. Nor has this question gained the prominence it deserves given its relevance to the Darwinian concept of 'survival of the fittest' which translates conveniently into 'survival of that species that outcompetes the others *in its niche* by producing viable offspring at a faster rate'.

During our daily business as scientists, we pursue certain questions, we produce (or re-iterate) certain concepts. To be good scholars, I believe we need to constantly question ourselves – the words and methods we use, our starting and end points, the views and beliefs our narratives imply even if we might mostly not choose to propagate them deliberately. As scientists working with living organisms, we are automatically evolutionary biologists, and hence have been given the opportunity to work in the framework of the most comprehensive and evidence-based explanatory narrative there is. We should strive to not distort this framework.

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Laudatio B. Wittrock,

R.Vanderstraeten

Professor Björn Wittrock from Uppsala University in Sweden is the second scholar, whose work and career we are able to honor today with the George Sarton Medal. As far as I know, the career of Björn Wittrock encompassed a period of about half a century. Throughout a large part of this career, Björn Wittrock was able to combine his scholarly work with important administrative responsibilities. He was, perhaps most importantly, the founding director of the Swedish Collegium for Advanced Study in the 1990s. And he remained Director and Principal of SCAS – as it is known – for nearly a quarter of a century. We honor today both aspects of his career, not in the least because they seem to have been two sides of the same coin, driven or motivated by similar concerns.

We have spoken before of the rise of specialized disciplines within science. The disciplinary structure became widely institutionalized and consolidated in the 19th century and still plays a major role in the present era. Disciplines, such as physics, biology, history, psychology, or sociology, still give structure to the world of science at both the cognitive and the organizational level. The university is for the most part organized around disciplines and subdisciplines, and many of the high-ranked journals in which scholars are expected to publish their work clearly belong to a specialized field of research (physics, biology, history, psychology, sociology, and so on).

Already at the end of the nineteenth century, the growth of science was characterized by a seemingly ever increasing variety of both small and large specialties. “As specialization was introduced into scientific work”, the sociologist Emile Durkheim noted at that time, existing Leonardesque ideals about intellectual labor had to be given up: “science, carved up into a

host of detailed studies that have no link with one another, no longer forms a whole" (1893/2014, p. 279). For George Sarton, too, heterogeneity and mutual incomprehensibility were becoming the counterpart of increasing specialization. He saw in the early-twentieth century that increasing specialization within scientific disciplines and sub-disciplines was calling the unity of the world of science into question; and at the same time he very much hoped that his own efforts at establishing the 'history of science' as a field of scientific research would be instrumental in clarifying and enhancing the unity of science.

The need for a systematic reflection on the conditions that determine scientific work, mostly within disciplinary or sub-disciplinary contexts, and the need to stimulate perspectives that transcend the boundaries of the traditional disciplines and that open up for interdisciplinary exchanges have not disappeared in the past decades. Quite to the contrary! These needs have persisted and it should be clear to us all that they still exist. As I see it, a concern with these needs and an openness both towards the history of our scientific disciplines and towards broader, interdisciplinary developments have been central throughout Björn Wittrock's career as a whole.

It is not difficult to recognize this openness in his own scholarly work. An interest in the history of the social sciences in relation to the history of society is visible throughout nearly all his publications. Björn Wittrock is, if I can say so, a book author and a book editor (more than a journal article author). Among his publications are five monographs and fifteen edited books. The titles of these books speak in this regard for themselves. I mention just a few examples: *Discourses on Society: The Shaping of the Social Science Disciplines*; *The European and American University Since 1800*; *The Rise of the Social Sciences and the Formation of Modernity*; or *Social Science at the Crossroads.* All of these books contain important contributions to the history of the social sciences.

But these concerns have also driven other choices made in his career. As Founding Director and Principal of SCAS, he has tried to create a setting, which stimulates and enforces interdisciplinary exchange. SCAS has brought together hundreds of leading scholars from different disciplines – and has been a model for other institutes for advanced study which did emerge in more recent decades. Björn Wittrock has also been one of the founders of NetIAS, the European consortium of Institutes for Advanced Study, and of SIAS, a consortium of leading institutes for advanced study

around the world (which includes, for example, the Institute for Advanced Study in Princeton). As only very few other scholars, Björn Wittrock has tried to create an environment which is supportive of disciplinary identities, but within which interdisciplinary exchanges become self-evident.

George Sarton, too, combined his own scholarly work in the history of science with tireless efforts to bring together other scholars and to facilitate their work. Sarton was, among other things, founding editor of the journal *Isis* and one of the founders of the History of Science Society. What George Sarton accomplished during his lifetime in terms of professional service is really impressive; what Björn Wittrock has been able to accomplish is more than impressive. I am, in short, confident that Björn Wittrock is a worthy recipient of the George Sarton Medal of Ghent University and I am happy that I have just been able to recognize and honor some of his many achievements.

Unexpected Affinities: Social Theory and World History, 1910 – 2023

The Rise of the Social Sciences: From Moral and Political Philosophy to Social Science

Björn Wittrock

In a long-term perspective, the social sciences constitute particular forms of human self-understanding that are characteristic of what might broadly be termed the modern world. In the course of the past three millennia, other forms of understanding have prevailed. This is true of those types of moral and political philosophy that emerged in China in the times of Confucius and Mencius as well as of classical Greek philosophy and, later, of the tradition of Roman law. It is also true of treatises on the ethics of governance and the legitimacy of rulers. In the course of the last two and a half millennia, discourses on these themes have often been associated with the emergence and development of the great world religions.

However, the social sciences—and indeed the word social science—originated in Europe in the late eighteenth century. In a complex process, new forms of knowledge emerged and replaced earlier forms of record keeping, of manuals for the education of princes, of royal regulations and prescriptions that in some countries might cover almost all aspects of social life, including prescriptions concerning dress codes for different social strata.

The social sciences became vehicles for grasping a situation in which human beings faced new uncertainties, where familiar categories of guilds and estates no longer sufficed to make sense of social reality. Indeed, in this new world, the concept of time itself seemed to expand from familiar

cycles of local experiences towards new horizons of expectations – to use Reinhart Koselleck's felicitous phrase.[1] In other terms, the social sciences became part of the efforts of humans to understand and to master this new and inherently uncertain world with the help of a new set of judicial, historical and, not least, statistical methods.[2]

Some areas of social science became demarcated disciplines already in the early nineteenth century. Thus economics, or rather political economy, gradually shifted its focus away from issues of from moral philosophy already at this point. At roughly the same time, university-based history emerged as a separate scholarly field with its own canon of rules. In the case of political science, it is in some countries, Britain being one example, not possible to speak of a clear demarcation of the study of politics from historical-philosophical studies until much later. In the case of sociology, the term was invented in the early nineteenth century. However, the scholars who are now described as the classics of sociology, in particular Max Weber and Emile Durkheim – and sometimes Vilfredo Pareto and Georg Simmel – were broad generalists. Their contributions and professional allegiances often were related to a range of fields, including the study of politics, economics, law, education, history and religion, and the term sociology often referred to a broad historical-comparative study of society[3].

They addressed questions such as concerning the nature of the social order that makes societies possible. They posed questions such as the following ones: How can we act and change the social order? What are the processes by which deep changes occur in the ways we live and act? What requirements have to be satisfied for a proposal to be scientific rather than a mere expression of sentiments? In other words, they engaged with questions that transcended disciplinary boundaries and referred to general problems of social theory.

1 Koselleck 1988. See also Joas 2010.
2 Brian 1994; Heilbron 1995; Heilbron, Magnusson and Wittrock 1998.
3 Raj and Sibum 2015; Wagner, Whitley and Wittrock 1991; Wittrock and Wagner, 1996; Wagner 2001; Wittrock 2001; Wagner and Wittrock 2008.

Consolidations of Disciplinary and Institutional Forms

The half-century preceding the First World War is an age in which the countries of Europe and North America underwent rapid social change on an unprecedented scale. Outside of this region, ever larger parts of the world became subject to European territorial expansion and acquisition on such a scale that the whole period is sometimes called an age of industrialism and but also of empire(s) and imperialism.[4] – to quote titles of historians such as Eric Hobsbawm, Henk Wesseling and, earlier, the Swedish triad of eckscherHeckscher, Heckscher, Karlgren and Wittrock.

This is a debate, however, that has to be seen in a wider intellectual context. Thus the intellectual historian H. Stuart Hughes (1958) in a now classical overview, *Consciousness and Society*, describes the period 1890-1930 as one in which an earlier confidence in the universal applicability of a naturalistic and positivistic programme to all domains of scholarship, was waning despite advances across a range of fields in the natural sciences. At the same time a variety of programmes for the incipient social sciences were competing with each other.

In the following, I shall examine how and why European and American scholars in sociology and social theory from the beginning of the twentieth century and up until the present have seen it as necessary to advance theories of social action and social change that explicitly include accounts of world historical developments. In practical terms, even the first steps towards such an analysis require a focus on a small number of scholars. It is also necessary to limit the analysis to a few key problems.

For practical purposes and in the present context, I can only outline some features of a focussed genealogy in terms of pairs of protagonists that has emerged and evolved in the course of the last century and the present one. Furthermore, the protagonists, that form the focus of the analysis, at a given point in time have known and have been aware of the scholarly oeuvre of each other. In addition, the latter pairs of the intellectual genealogy have also known the persons or at least the oeuvre of that of the predecessors. Hence, these scholars form a genealogy in the strong sense of the word.

[4] Hobsbawm 1987; Leonhard and Hirschhausen 2011; Wesseling 1996; Heckscher. Wittrock and Karlgren 1934.

Each member in the genealogy is aware of not only of contemporary contestants but also of the preceding ones and engage with them so that the genealogy becomes a sequential critique. However, it also constitutes a scholarly tradition held together by research foci that are not identical over time but jointly exhibit family similarity.

Ernst Troetlsch and Max Weber

At the turn of the twentieth century, many European scholars and observers took it for granted that a profound divide existed between their own religious faith, most often varieties of Christianity, with a foundation in religious experiences of divine revelation, and other forms of beliefs and practices. Simultaneously, however, the nineteenth century also witnessed a growing interest among European theologians in extra-European religions. In the early twentieth century this ushered in a debate about the possibility of a sociology of religion and, indeed, about the scholarly study of religion in general.

Hence, when the German theologian Ernst Troeltsch addressed the theme of the possibility of a scientific study not only in the form of church history but as a history that treated Christian religion as one among several world religions, this was a theme of interest to many intellectuals both within Protestant theological faculties at German universities and beyond. However, to many it was still an unorthodox stance and to some, including historically orientated Protestant theologians of an older generation, it was even a scandalous proposition.

Gradually, Ernst Troeltsch arrived at the conclusion that in all the "great and spiritual religions", a sense of "the Absolute" was present. However, this sense takes shape in intimate interaction with the entire cultural system of which it has become an integral part. A sense of the Absolute, he argued, which goes beyond the contextual limitations inherent in a religion, may only emerge as the result of a dialogue and a quest which is common to all these religions and which may ultimately usher in common conceptualisations that are as yet unknown.

In summary, Ernst Troeltsch came to adopt a position, shared by Max Weber, according to which world religions can be analysed as analogous in categorical terms and are amenable to scholarly analysis from both a theological and a sociological vantage point.

In contrast to Ernst Troeltsch, Max Weber came to develop a programme for the comparative study world religions. This, however, encompassed a study of the cultural worlds, i.e. the civilizations, of which these religions formed a constitutive part at least in genealogical terms. The most extensive scholarly work, which was prepared for publication by Max Weber himself, are the three volumes, more than 1400 pages of text, of the "Collected Essays on the Sociology of Religion" (*Gesammelte Aufsätze zur Religionssoziologie*).

These volumes constitute a historical and comparative analysis of the early history of the great world religions. Already in the preface to the volumes, Max Weber argues that the ultimate rationale for this wide-ranging analysis is the need for an examination of the forms of ethics and sociality that have underpinned economic activities in various parts of the world. In particular, there is a focus on a number of civilisations in the Old World. More specifically, there is an overview of civilisations that emerged in conjunction with processes of not only institutional change but also of a profound rethinking of the relationship between mundane activities and imaginations of a transcendental sphere, i.e. what later came to be called the Axial breakthrough. In particular, the first volume has a focus on Confucianism and Daoism, the second on Buddhism and Hinduism and the third on Ancient Judaism.

In practice, Max Weber's analysis rests on a wide reading of available research in the English-, German- and French-speaking worlds at the turn of the twentieth century on elements of a broad social, political and intellectual history of parts of East Asia, South Asia and the Middle East. Max Weber's objective, however, explicitly stated already in the preface, is to examine why modern science, a modern rational bureaucracy and a modern rational capitalist economy have emerged and fully developed only in, the Occident, to use Weber's expression. These features are, Weber asserts, of universal significance.

This marks two persistent tensions in Weber's work. In one sense, he is convinced that Europe, more recently together and in competition with the United States, has led a development of universal importance. On the other hand, the scale of his inquiry is global. Why, a critic might ask, does Weber have to amass such a wealth of empirical and historical findings, if they refer to phenomena that lack universal significance? The overt answer of Weber is that the broad range of analysis permits an identification of a more precisely delimited set of phenomena that were necessary and suffi-

cient for the Occidental breakthrough but that to varying degrees have been historically absent in other parts of the world. It is clear, however, that this answer is a partial one; it cannot possibly account for the full breadth of data accounted for by Weber in the three volumes on the sociology of the so-called world religions.

However, there is also another answer. Throughout the volumes, the style of writing is one in which Weber is involved in a dialogue with himself, advancing a thesis and then halfway, but often indirectly, undermines or brackets the validity of his own thesis. While he is convinced that Occidental developments constitute advances, he constantly reflects on and points to consequences of them that delimit our experiences but also have tragic consequences. The scale of devastation of the World War was a consequence, Weber points out in a comparison with the prehistory of science in South Asia, of an elimination of earlier close links to aesthetics and to the rationalisation of scientific work in the form of experimental, laboratory-based science.

Weber's engagement with antinomies and various layers of interpretation combined with an expressive preciseness of style exert a fascination on many readers.[5] However, it may occasionally leave some readers with a sense of having to disentangle an argument of gradually increasing complexity up to a point when the rationale and conclusion of the argument appear to elude further analysis. This is, for instance, a thesis advanced by Hans Joas in his analysis of the section of the famous *Zwischenbetrachtung* ("intermediate observation") at the end of the first of the three volumes in which Weber explores processes of interaction between the increasing rationalisation or internal dynamics of different so-called social spheres.

Social Science in the post-Second-World-War Era, 1945-1972

The international consolidation of the social sciences in the period after the Second World War was promoted by a series of international organisations, including UNESCO and also the OECD. In the last instance, this also meant that the global diffusion of social sciences in the era after

[5] It is, for instance, fascinating to try to follow Weber when he, without extensive argumentation, states that among the world religions there are three and only three that have arrived at statements about the problem of theodicy that fulfil Weber's, largely non-explic2ated, set of conditions of adequacy for constituting a solution to the problem.

the Second World War was influenced by the country that had come to occupy a dominant international position but was also the country with the largest number of social scientists, namely the United States.[6]

This influence, though, while substantial in terms of professional organisations, was by no means hegemonic. In many countries, not least Britain and France, there were long-standing and deep intellectual traditions that continued to mark scholarship in these countries and the ways in which social scientists and scholars interacted with colleagues abroad but also with institutions in their own countries, including colonial institutions.

In the German case, the defeat of the Nazi regime forced a degree of self-reflection sometimes captured by the phrase "the year zero". However, this also meant comprehensive efforts to rethink and re-establish pre-Nazi forms of humanistic scholarship. In the countries of Western Europe as well as in North and South America, the overall trend in the decades after the Second World War, involved a strengthening of the level of funding for the social sciences as well as a growth of international professional associations. This led to a consolidation of the social science disciplines but also to the loss of some older traditions and to the erection of new boundaries between various social sciences but also tendencies to a greater distance between historical research and social science.

Apart from increased funding, there were also profound changes of the substance of disciplines in the United States and many other countries. These changes were often described in terms of a so-called behavioural revolution. This reflected an ambition to make the social sciences more akin to natural sciences. The phenomena of social science should be subject to systematic observation. They should be measured and counted and examined by quantitative methods. This would allow social scientist to identify the causes of different forms of social change. Ultimately, this should lead to the discovery of laws governing human behaviour and of societies.

This programme inspired many scholars but also gave rise to strong opposition. Critics saw the programme as simplistic and leading to a loss of knowledge acquired by other means. In practical terms, it also became clear that while statistical generalisations could be formulated with the

6 Ross 1991; Manicas 1998: Wagner, Weiss, Wollmann, Wittrock 1991.

help of various correlation and regression analyses, these generalisations rarely, if ever, could be said to constitute a law in the sense that such laws were formulated in the exact sciences.

In the end, most social sciences were affected to some degree by the so-called behavioural revolution and by other efforts to put increased emphasis on the use of quantitative methods. This development was perhaps most conspicuous within the discipline of economics and psychology.

However, in the first two and a half decades after the Second World War, another major substantive development affected large parts of the social sciences. This was the development of a comprehensive theoretical system that aspired to link together disciplines such as sociology, psychology, anthropology and political science.

The key proponent of these developments was a Harvard professor of sociology who throughout the whole quarter of a century after the Second World War, arguably, became the most influential sociologist, not to say social scientist, in the United States and perhaps in the Western World at large. His name was Talcott Parsons. In the 1920ˢ, he visited both the London School of Economics (LSE) and the University of Heidelberg were he established contact with the circle and family of Max Weber's. Parsons also finished and presented a doctoral dissertation at Heidelberg in 1927 before going back to take up a position as instructor in economics at Harvard but later became attached to the Department of Sociology that had been established in 1930. He took it as his task to introduce the thinking of Weber in North America and in the Anglo-Saxon world at large and he translated several of Weber's works. In many ways. Parsons saw himself as something of a custodian of the legacy of Max Weber.

In this, however, he was not alone. In fact, one of his teachers at Heidelberg, was the psychologist and philosopher Karl Jaspers who had given the speech in the Great Hall of the University of Heidelberg after Weber's death and who had come to Heidelberg long before Parsons and had an established position in the Weber circle. Thus, Jaspers and Parsons were

fully aware of each other. However, they rarely, if ever, referred to the works of each other.[7]

In 1944, Parsons accepted an offer from Harvard University to take responsibility for establishing a new social science department. Within a relatively short time, Parsons emerged as the most prominent Harvard sociologist and in 1946 a new department of social relations was created that comprised sociology, psychology and anthropology. A long list of scholars, who later were to occupy prominent positions in American social science, were trained at this department. Parsons himself was a prolific writer who developed a comprehensive conceptual scheme for all societal phenomena. Linked to this scheme was also a theory of the formation modern societies and an account of how social actions and institutional features of societies are linked to each other. One aspect of this became the so-called modernization theory, grounded in a so-called structural-functional theory. It held out a promise that it could provide tools for an understanding of developments in countries across the world.

In the 1960ˢ, these efforts became the target of sustained critique from other social scientists. They argued that modernization theory and the so-called structural-functional analysis of social events and phenomena tended to neglect both micro-events and individual human beings but also to yield an insufficient understanding of historical change on a macro-level. Furthermore, some critics argued that Parsons' scheme had an implicit conservative bias.

In this situation, Parsons wrote a small book with the title "Societies: Evolutionary and Comparative Perspectives" (1966). It aspired to provide the core of an account of the history of humankind from so-called primitive

[7] However, Parsons wrote the entry on Jaspers in the biographical volume of the *International Encyclopedia of the Social Sciences* that appeared in 1979, i.e. ten years after the death of Jaspers and in the same year that Parsons himself passed away. Parsons' text is respectful and bears witness to Parsons' extensive familiarity with German intellectual and philosophical history. The text has a dual focus. On the one hand, it situates Jaspers' oeuvre in the context of German philosophical development from Kant onwards. On the other hand, it argues that Jaspers' position can be located to several balancing points of relevance for the philosophy of social science. However, the entry does not make any effort to assess the historical or sociological value of those writings of Jaspers that have such a focus. This is true of Jaspers' work on the idea of the university that appears in the bibliography but not in the essay itself. As to Jaspers' book on the origin and goal of history, it is not mentioned in the text, nor in the bibliography. It is difficult to imagine that it would not have occurred to Parsons that Jaspers had outlined an analysis, 15 years before the publication of Parsons' book "Societies", that engaged with analogous issues as Parsons' publication. Thus, the entry tacitly, but decisively, delimits the sphere of mentionable scholarly contributions by Jaspers to the strictly philosophical sphere, albeit with some regard for Jaspers' psychological writings.

societies, from the "archaic societies" of Ancient Egypt and Mesopotamia and via the "historic" so-called intermediate empires of China, India, the Islamic Empires, and the Roman Empire. The book also emphasized the particular role of the so-called "seed-bed" societies of Ancient Israel and Greece for world historical developments.

This little book can perhaps be characterised as an effort to outline a global history of human civilizations and to link this to Parsons own theoretical system, thereby demonstrating that accusations of narrowness and bias against Parsons were off the point. This is still a fascinating book that at least partially took its form in the context of a series of seminars that were given at Harvard in the spring semester of 1963 by Talcott Parsons together with two younger colleagues, namely Robert Bellah and Shmuel Noah Eisenstadt. The following year the American Sociological Review published an issue on evolution with contributions by these three scholars as its centrepiece. Jointly these three articles and the parallel books by Parsons on "Societies" and by Shmuel Eisenstadt on "The Political System of Empires" exhibit a striking parallel to themes raised in Max Weber's three volumes on the sociology of the great world religions.

However, already a decade and a half before this issue appeared, Karl Jaspers had published a little book with the intriguing title "The Origin and Goal of History". This book was remarkable for several reasons, not least because it explicitly renounced a Eurocentric and Christocentric global history of the last two and a half millennia. It also launched a concept that was to stay in intellectual contestations throughout the century and beyond, namely that of the Axial Age. [8]

In the landscape of rapid change and rethinking in the social sciences in the late 1960[s], the position of Talcott Parsons' became increasingly challenged. In 1968, the International Encyclopedia of the Social Sciences appeared in 17 volumes – and with an eighteenth biographical volume published a decade later. In many ways, it summarized the scholarly achievements of the social sciences in the post-Second World War era, many of them a result of work at the extremely productive department of social relations that had been set up in conjunction with the recruitment of Talcott Parsons to Harvard University. This department had, as mentioned, opened in January 1946 and had exerted a formative influence on a long list of leading social

[8] Jaspers 1949.

scientists. However, already in 1967, the first step was taken in a process that five years later would result in the de facto disestablishment of the famous department.

Years of Rupture and New Departures, 1972-1991

With the gradual fading of Parsons' role as a theoretical master-guide to social science theorising, there was suddenly room and a need for alternative theoretical developments. They occurred against the background of deep changes underway in the international landscape. It was in this context that new macro-theories of dependency and of world systems were proposed, mainly elaborated by Immanuel Wallerstein with inspiration from Ferdinand Braudel, a key representative of the so-called Annales school in French historiography. Within these frameworks, the conceptual pair of centres and peripheries as well as the transition between different stages of world systems became paramount.

There were also efforts to explore and articulate ideas that had their background in variants of linguistic philosophy as well as of structuralism that had been suggested already in the 1950s but that were now gradually assuming a more prominent position. The discipline of economics had largely continued and refined rigorous forms of both micro- and macro-theory. Now, however increasing efforts were made to link such forms of theorizing both to economic history but also to empirical or experimental studies of economic behaviour. Furthermore, there were efforts to develop synthesizing modes of analysis such as evolutionary economics, economic sociology and so-called socioeconomics.

A persistent theme in the development of social science in the 1950s and early 1960s had, as observed above, been a contestation around the efforts of some scholars to mould the social sciences in a naturalistic direction. These often embraced the idea that the social sciences should formulate their explanations by reference to social laws or at least law-like generalisations, whereas their opponents regarded such efforts as misconceived and unrealistic. Another key contestation had focussed on the ability of so-called structuralism-functionalism to provide satisfactory explanations of social phenomena. These two contestations became linked to a debate about the role of philosophical logical positivism and empiricism. With the

benefit of hindsight, the terms of these debates often appear ill-founded. In particular, by the late 1950s, philosophers, coming from the tradition of logical empiricism had long abandoned the simple formulations that became the focus of many of the hotly contested debates in the social sciences in the 1950s and 1960s.

In the 1970s and 1980s, some of these contestations continued but their foci changed and perhaps the most prominent as well as persistent contestations concerned the problem of agency. Talcott Parsons' research programme had been outlined in a book published in 1937 with the title *The Structure of Social Action*. However, by the 1970s, it was often argued that Parsons' account in this volume and in its subsequent elaborations failed to explain human actions. Instead, his works were seen to have set the stage for a tendency to subsume human actions under broad categories or to see them as instantiations of a hypothetical social law or generalisation or of a pervasive social structure. It was also, some scholars argued, inappropriate to see all forms of human action as only a manifestation of an effort to try deliberately to maximize individual utility.[9] At the same time, most social scientists did not want to disregard the existence societal structures that impinged upon and constituted the framework of human actions.

Thus, these years saw the development of a range of accounts dealing with the duality of agency and structure, many of them influenced by the rising interest in theorizing the concepts of gender and of nature. Two prominent examples of efforts to achieve a kind of theoretical breakthrough in this domain were those of Anthony Giddens and of Pierre Bourdieu.

Giddens' theorizing had as one of its backgrounds so-called ordinary language philosophy, with an influence from both the late Wittgentsein and from John Austin, to name but two philosophers. Giddens linked this up to elements of French structuralism as well as to some elements of radical social theory with at least a distant echo of the early writings of Marx. Giddens also refers to the Swedish geographer Torsten Hägerstrand as a source of inspiration for his analysis of the interaction of time and space and for his explication of the concept "locale".

Giddens argued that the capacity of human beings to perform actions had to be related to their capacities as well as to their intentions. He called his form of analysis structuration theory. It is a theory that explicitly seeks

[9] See e.g. Joas

to account not only for repetitive and institutionally strictly constrained actions but also includes a recognition of the creative elements in agency, resting on the assumption that human beings are often but "knowledgeable" and "competent" to act even in a complex and structured society.

Giddens used this form of analysis to address a vast number of societal phenomena, including globalisation, the modern nation state, wars and class structures. Eventually, he was also taking up an important leadership role in the British university system, namely as Director of the London School of Economics and Political Science. Furthermore, he achieved a unique position to probe some of the possible consequences of his social theory through his role as a key advisor to the British Prime Minister, Tony Blair.

Pierre Bourdieu had done some of his earliest research in the form of anthropological studies, also drawing on questionnaires, in French Algeria in the 1950s. These studies made him acutely aware of the brutality of colonial warfare.[10] They also served as an impetus for his further search for forms of analysis that would be able capture the inequalities of modern societies.

Bourdieu was in some ways a researcher in the tradition of French structuralism. However, he also transcended as well as extended this tradition by seeking to include an analysis of agency. In this effort, he introduced two seminal concepts, namely first a notion of not only individual actions but of properties that served as dispositions for different actions. For this purpose, he proposed the term "habitus" to designate the socially conditioned form of such dispositions. In order to account for the actions that emerged out of different sets of dispositions, he also pointed to the fact that actions are not arbitrary. Instead, they often tended to be geared towards the achievement of an increase in so-called cultural capital.[11]

It is easy to see that this type of analysis has great heuristic value. Furthermore, Bourdieu attracted and inspired young scholars, disciples and adherents from an amazing range of different disciplinary backgrounds. Like Giddens, he was a prolific author and also a highly prominent scholar in the public sphere. Both of them contributed to give social science a much more visible position. They also came to demonstrate different avenues open to engaged scholarship and research on a transnational scale.

10 Pérez 2023.
11 Fabiani 2021.

With the benefit of hindsight, though, it now appears that the extremely ambitious research programmes of these two scholars have been inspirational for generations of social scientists in the latter half of the twentieth century. Yet, it remains unclear, and perhaps even unlikely, that they will be able to achieve a position analogous to that that of the most prominent of the so-called Classics of sociology and social theory in their time and sometimes well beyond.

Rethinking History in a World of Upheavals, 1991-2023

The social sciences currently face a series of antinomies and tensions that concern their professional standing and their reproduction in university systems across the world in a situation in which universities have become global gateways into the world of modernity. At the same time, the social and human sciences face calls for a re-examination of some of their tacit presuppositions. Thus, some observers have characterised Weber's global historical analysis as ushering in a "sociology of absences".[12]

Analogously, modernisation theory continues to thrive, even though it still may carry an intellectual baggage that is heavy and often unhelpful. Thus, it seems to flourish in the guise of studies of the global dispersion and borrowing of ready-made institutional models. It sometimes also appears in studies within rising great powers. However, despite its particular institutional guise, it is a form of theory that often invites thinking along rigid intellectual tracks and that is unwilling to welcome too much variation and too many divergences from an imagined masterplan. Thus, there is a need for a scholarly imagination that allows an understanding of societal transformations through engaging in, to use Stephen Pollock's felicitous term, "comparison without hegemony". [13]

However, this occurred in an international political and economic landscape that changed radically between 1990 and 2020. Even if deep concerns about the human environment and climate change were raised in the 1960[s] – and in 1972 ushered in the first large UN conference on the human environment – the sense of urgency around these issues grew year by year in the new century. The Intergovernmental panel on climate change

12 Arjomand
13 Pollock 2010.

had been formed in 1988 – with a social science initiative a few years later, the Human Dimensions of Global Environmental Change. However, issues of climate, environment and sustainability came to shape social- science research programmes significantly more from the middle of the first decade of the new century onwards than had earlier been the case.

In the economic sphere, information technology came to impinge on every aspect of economic but also everyday life. In the 2020s, issues of machine learning turned into existential issues about artificial intelligence, affecting academic life in the most practical terms, such as grading essays, but more generally concerning conceptions of human life. Furthermore, the imaginations in the early and mid-1990s of an end of both history and wars were replaced in the years around 2020 by a stream of events that seemed more reminiscent of events of the 1910s and 1930s than of the visions of perpetual peace that appeared in the wake of the implosion of the Soviet Empire. Many of these events led to public movements and manifestations.

However, inadvertently several of these long-term changes also served as a stimulus for the re-emergence of forms of naturalistic thinking in the social and human sciences. Thus, in social- science climate research, new programmes for research from a so-called planetary perspective were articulated, involving interaction between social theory, earth sciences and meteorology. Close to philosophy, psychology and linguistic research, the cognitive sciences with their strong components of neuroscience and with clear implications for artificial intelligence exerted an analogous influence. Within sociology, finally, the critique of functional explanations and mass behavioural surveys metamorphosed into a new form of analytical sociology at the intersection of social theory, network analysis and applied mathematics.[14]

As a result, academic social science experienced both exposure to broad streams of public engagement and opinion and tendencies to embrace new forms of naturalism. This naturalism differed from that of the behavioural revolution of the 1950s and 1960s. It was less a matter of trying to emulate the natural sciences. Rather some fields of the social sciences were entering such a close collaboration with life sciences and natural sciences that their links to interpretive social science and to the humanities became tenuous to the point of nearly ceasing to exist.

[14] Peter Hedström 2005, 2009a, 2009b, 2019.

Against this background, with all its antinomies, but also the need to explore ideas such as that of comparison without hegemony, the problem of achieving an understanding of the modern world in a long-term historical context was being re-examined. Two key scholars in this area in the latter half of the twentieth and the first decade and a half of the new century are the co-contributors with Talcott Parsons to the remarkable, and already mentioned, 1964 issue of the American sociological review on the theme of evolution, namely Robert N. Bellah and Shmuel Noah Eisenstadt. As already indicated, there is a striking parallelism between the delimitation in terms not only of temporal foci but also in terms of the objects of inquiry between Weber's version of a social theory of global history and later works that engage with the idea of the Axial Age. This concerns to some extent the two concise volumes, published at mid-century and discussed in a previous section, namely Karls Jaspers' and Talcott Parsons' volumes on the origins and goal of history and on societies, not least "seed-bed societies", respectively.

In this context, four works appeared that were on the same monumental scale as that of Max Weber's oeuvre, namely, first, works of two towering late twentieth century and early twenty-first century scholars who had long engaged with this conceptualization within a sociological framework, namely Robert N. Bellah and Shmuel N. Eisenstadt. In the final section two equally monumental works will be taken up, namely those Jürgen Habermas and Hans Joas. These latter works appeared only towards the end of the second decade of the twenty-first century and are not yet fully translated into English and, in Joas' case, with only two volumes of an envisaged trilogy yet published.

Robert Bellah: The Axial Age in Human Evolution

Robert Bellah was sometimes called "Parsons' favourite disciple".[15] However, this term does not do justice to the range and depth of his scholarship, nor to the historical ambitiousness and personal courage that characterise Bellah. In his biography of Bellah, aptly titled "A Joyfully Serious Mann: The Life of Robert Bellah", Matteo Bortolini describes Bellah's "lifelong obsession with One Big Idea – his original plan to write 'the first

[15] Bortolini 2021.

good book in the sociology of religion since Max Weber' – as he used to tell his closest students at Harvard in the early 1960s." [16]

However, in late 1997, "at seventy he saw his scholarly career, rich and fulfilling as it had been, as a long detour away from his life's work, and explicitly announced that his major book was 'yet to be written'." [17] This book, of 746 pages plus an incisive preface of 15 pages, appeared in 2011 with title "Religion in Human Evolution: From the Paleolthic to the Axial Age". In the final paragraph of the preface, Bellah states the following: "This book asks what our deep past can tell us about the kind of life human beings have imagined was worth living … It is not a book about modernity. But surely, as Leszek Kolakowski has eloquently put it, modernity is on trial. I cannot in this book give an account of that trial. All I can do is call up some very important witnesses."[18]

One important concern in Bellah's analysis is to grasp the characteristics of religious practices in two main types of pre-Axial societies, namely tribal societies and large so-called Archaic societies. Thus, in early tribal societies, the invocation and articulation of mythical beliefs in ritualistic practices would normally serve the social and cultural coherence of a collective. This would involve practices outside of the bounds of day-to-day practices of production and reproduction. They might also involve or usher in changes in the collective life of a community. In this way, myths could be reinterpreted and supplanted or even replaced by additional myths, as could imaginations about the primacy of different forces or divinities associated with the different forms of myths.

In large-scale Archaic societies with rituals performed by Emperors or other centrally placed rulers, occasional and irregular, but inevitable, catastrophic external events, involving e.g. draughts, famines, pandemics and flooding, might lead to questioning and reinterpretations but rarely, if ever, to a fundamental challenge to notions of an ideal cosmological or societal order.

In other words, in both types of pre-Axial societies, there might be, Bellah argues, instances of disruption but rarely ushering in more than a partial adaptation. This can only occur, Bellah argues, in a critical reflection and rejection of some myth by way of questioning its premises or engaging in a

16 Ibid., p. 298.
17 Ibid.
18 Bellah 2011, p. xxiv.

comparative exposition of its merits and shortcomings in, say, a Platonic or Aristotelian, dialogical form. This type of self-reflection appeared only in some societies in the Old World around the middle of the first millennium BCE. This change is profound enough to justify the designation Axial Age and it a primary task for Bellah to identify the nature of those civilizations where this first occurred.

In some ways, Bellah's argument is similar to Jaspers'. However, it is incomparably more extensive and based on a careful reconstruction of historical scholarship – and on Bellah's own linguistic competence in both Chinese and Arabic. It is also, contrary to Jaspers' and Eisenstadt's inquiries, grounded in – the expression "inspired by" seems too weak – an evolutionary perspective represented, not least by the works of Merlin Donald, in particular his book "Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition" (1991). This book provides an evolutionary grounding of the idea of the Axial Age. It has also given rise to an interest in this idea among cognitive scientists.

Bellah's project on religion in human evolution was meant to be carried on beyond the original Axial Age. Alas, Robert Bellah's death in July 2013 means that it is left to his closest collaborators to judge if manuscripts covering later periods exist and should be published.

Shmuel Eisenstadt and the Renaissance of a Sociology of World History

Shmuel Noah Eisenstadt's oeuvre present to some extent a parallel to that of Bellah. was born in Warsaw on 10 September 1923. He came to Palestine with his widowed mother in 1930. In 1940 he began his studies at the Hebrew University of Jerusalem in 1940. Among his teachers were the historian Richard Koebner and the social philosopher Martin Buber (who had studied with both Wilhelm Dilthey and Georg Simmel).

After graduating at the Hebrew University, Eisenstadt spent a post-doctoral year, 1947/48, at the London School of Economics and Political Science (LSE), where he pursued his early interest in Max Weber's comparative historical sociology with Edward Shils as one of his teachers. That year he was also introduced him to the comparative institutional analysis that had long been a hallmark of British sociology and social anthropology.[19]

[19] See also Kedar, Silber and Klin-Oron 2017.

At least for a time, and in particular in the 1960ˢ, he was often perceived as a representative of the structural-functionalist school that came to occupy a dominant position in much of social science.

Eisenstadt's early studies had a focus on the study of migrations, generational change and cultural and practices. Already in these early works, there are two features that came to pervade virtually all of his works, namely an emphasis on antinomies and inherent tensions and- what might be termed – a dialogical view of human action and society.

In 1963 his early magnum opus appeared, namely *The Political System of Empires*. This book made him famous throughout the scholarly world of social science. It analysed structural features and contestations, which appeared in imperial societies, over the control and use of free resources in societies where a large share of all resources were bound up in traditional settings beyond the control of a central imperial apparatus.

However, gradually Eisenstadt's research took a new direction during the second half of the 1970ˢ onwards. Max Weber's collected essays on the sociology of religion and Karl Jasper's book *Vom Ursprung und Ziel der* Geschichte played an important role for this. Together with a prominent Weberian scholar, Wolfgang Schluchter, Eisenstadt made the idea of the Axial Age the focus of a sustained research programme. This programme came to involve humanistic scholars in fields such as Egyptology, Assyriology, Sanskrit studies, History of Religion, Sinology but also a small number of social scientists with an interest in the analysis of societies and cultures in their historical contexts.

This programme of collaborative and empirically orientated research helped transform Jaspers' bold hypothesis of an Axial Age into an object of a vast amount of humanistic but also social scientific research. It connected a group of sociological generalists with a large number of historians, archaeologists and linguists with deep expertise in the field of the civilizational history of the parts of the world that had been but hastily dwelt upon by both Parsons and Jaspers. The focus of this research

Was shaped by Eisenstadt's interests in Weber's comparative studies of long-term historical change. Furthermore, it went beyond a North Atlantic perspective, given that the key sites of the Axial breakthroughs were located in the Eastern Mediterranean, the Middle East and in South and East Asia. A succinct presentation of the early part of his project together

is given in the edited volume *The Origins and Diversity of Axial Age Civilizations* (1986). The most extensive exposition of the work of the later of the research programme is the large edited volume *Axial Civilizations and World History* (2005).[20]

Shmuel Eisenstadt also maintained an interest in exploring the relevance of studies of the early history of the great world religions to an understanding of the modern world. It is in this context that he proposed the idea of early modernities as well as multiple modernities as an alternative to classical modernisation theory.

More systematically than perhaps any other social scientist, Eisenstadt argued against the identification of modernity solely with a Western tradition. Even if the contemporary world is characterized by a belief in the potential of human action to achieve formerly unimaginable changes in the human condition, there are many different sets of such beliefs and many different institutional paths. In works on India, China, Japan – in particular his study of *Japanese Civilization: A Comparative View* (1996) – and of Islamic societies, Eisenstadt was able to demonstrate that these societies in fact exhibited both cultural and institutional features, typical of modern societies, at a much earlier stage and in much more widespread form, than scholars had assumed. In parallel to this, Eisenstadt also explored revolutionary transformations of the modern age, for instance in his monograph *The Great Revolutions and the Civilizations of Modernity* (2006).

Contemporary Crossroads: Jürgen Habermas and Hans Joas

At the beginning of the twenty-first century it became increasingly evident that questions about the history and future of humankind could not be limited to accounts of the achievements of a relatively small number of North Atlantic societies in the course of the last two or three centuries. Shmuel Eisenstadt's proposal that the implications of a notion of multiple modernities be spelt out and that ancient history might profit from exploring the hypothesis of an Axial breakthrough in human self-reflectivity, emerging at different global locations, reflected such concerns.

[20] Eisenstadt, Arnason and Wittrock 2005. See also Wittrock 2015 and 2021 but also Arnason and Wittrock 2004.

Towards the end of the second decade of the century, two prominent sociologists, namely Jürgen Habermas and Hans Joas, have written major books that address these themes from a vantage point in which an analysis of the Axial Age is of constitutive significance.

Jürgen Habermas: Constellations of Faith and Knowledge and the Occidental Genealogy of Reason and Liberty

In his late magnum opus, *This Too a History of Philosophy*, to quote the title of the not yet published English translation (first German edition, 2019), Jürgen Habermas explores the complex and rich genealogy of philosophical efforts to articulate forms of reasoning that have eventually helped demonstrate links between notions of reason and liberty.

In Habermas' case, this genealogy takes its starting point in the period of the Axial Age. In fact, the idea of the Axial Age is introduced by Habermas already in the preface to the first of the two volumes, the one with a focus on *The Occidental Constellation of Faith and Knowledge*. He pursues it throughout this volume, in which it is a main theme of the analysis for some 300 pages. The idea recurs in many instances also in the following volume, *Rational Liberty. Traces of the Discourse on Faith and Knowledge*. In this analysis, Habermas is elaborating an account that in many ways is in close proximity to Weber's account of the ethics of world religions.

In both volumes of Habermas' *oeuvre*, there is a sustained engagement with the question about the relationship between an "occidental constellation" and the gradual emergence of a political philosophy with a focus on exploring inextricable links between notions of reason and liberty. However, Habermas' analysis also takes up ideas among some social theorists, including John Meyer and Johann Arnason, about properties of a world society or of a global, if diverse, modernity constituting a form of civilization *sui generis*. Thus while Habermas' analysis has a focus on a broadly defined occidental genealogy, this does not entail negligence of or indifference to analogous developments on a global scale both in antiquity and in the modern world.

In fact, there is a near book-length long section in the first volume devoted to "a tentative comparison of axial-age world imaginations". In this section, Habermas has a focus on the same cultural worlds that Weber analysed in

his study of the ethics of economy of the world religions. Thus, Habermas discusses ancient Judaism, Buddhism, Confucianism and Daoism, and philosophical developments in Ancient Greece but leaves the Iranian case to the side, as did both Weber, although not entirely so, and Bellah.

Habermas' inquiry has a focus on ideational phenomena. It includes reflections on societal and contextual elements of these developments. However an analysis of societal, economic and even geographical aspects of the type that Weber, and to a considerable extent also Eisenstadt, engaged in, is not pursued unless there is an immediate relationship to the formation of different constellations of Faith, philosophy and knowledge.

Habermas points to the fact that Japsers had been stimulated in his effort by Max Weber's studies on the sociology of religion. However, Habermas emphasises that despite these efforts of Jaspers, it is only with Shmuel Noah Eisenstadt that the historical philosophical concept of the Axial Age becomes the focus of an interdisciplinary research programme. Furthermore, he stresses that it is only through the embedding of the concept in this research context, with social scientists playing a key role, that the seminal nature of the concept has becomes apparent. Religions are, Habermas continues, not only reflected in the cognitive dimension of imaginations of the world; they are also constitutive of the structuring of early socio-cultural forms of life in their entirety.

Habermas argues that through religious transmutations in Antiquity, in particular the emergence of a Christian version of Platonic thought in the Roman Empire, an important point is marked in the development of a genealogy. This development will eventually usher in the emergence of – to use Habermas' term – a post-metaphysical strand of thought that in the course of the nineteenth century will became a linguistically interpretable embodiment of an idea of liberty grounded in reason.

From the early traces in late Antiquity, he explores this genealogy in the Medieval period and then analyses its further articulations in the early modern and modern periods with Hume and Kant eventually outlining two main philosophical paths. Thus, in this account the conjoined idea of reason and liberty is a phenomenon of post-metaphysical thought, drawing on Kant but, in Habermas' account, with a critically significant step taken with the emergence at the turn of the eighteenth century and in the early nineteenth century of philosophical and linguistic notions, formulated by

Herder, Schleiermacher and Wilhelm von Humboldt. Thereby notions of reason and liberty are no mere conceptual formulations. Rather they turn into ideas that take societal form via language and communicative processes with knowing and acting human beings at the core of the analysis rather than ideas about an objective spirit.

In this genealogy Ludwig Feuerbach, Karl Marx, Sören Kirkegaard, but also American pragmatism, in particular Charles Sanders Peirce, are some of the significant participants in an exploration of the possibilities to formulate a post-metaphysical idea of reason and liberty. Jürgen Habermas himself has, arguably, contributed more than any other social philosopher to the articulation of these types of ideas in the present age.

Throughout the two volumes, Habermas also returns to and expounds themes that he has made pioneering contributions to earlier, including the theme of the legitimacy of governments, incidentally another issue where the research interests of Habermas and Eisenstadt meet.

Finally, Habermas himself has ventured outside of the occidental constellation to which he refers. However, it is in the case if this constellation that his analysis has ushered in a rich genealogy that is pursued by way of a detailed argument at every step. Hopefully, this analysis may entice scholars to explore analogous genealogies in the history of philosophy and political thought of other cultural worlds. If so, the potentials will be enhanced for an understanding of conditions for the emergence of different contemporary constellations of reason and liberty – with distant echoes, if transmuted, from different regions of the world of Antiquity.

Hans Joas: The Power of the Sacred and the Critique of the Narrative of Disenchantment

Hans Joas is now Ernst Troeltsch Professor for the Sociology of Religion at the Humboldt University of Berlin. He has previously been a Permanent Fellow of at the Freiburg Institute for Advanced Studies and before that Director of the Max Weber Centre for Advanced Cultural and Social Studies at the University of Erfurt. He is Visiting Professor of Sociology and Social Thought at the University of Chicago and a Member of the Committee on Social Thought at that university. He has also been affiliated with many

other institutions, including the Swedish Collegium for Advanced Study in Uppsala at which he has served as a Non-residential Long-term Fellow.

Hans Joas has emerged as one the most articulate contemporary social theorists. His book on *The Creativity of Action* (original German edition in 1992 and English translation in 1996) outlining a comprehensive theory of action. In particular, this book refused to reduce the problem of action to a problem of the nature of means-ends-rationality. Instead he also proposed that other types of action also be included, be they norm-guided actions or forms of transformative action that Hans Joas has analysed in terms of the creativity of action.

In a further step, Joas extended his inquiry to include studies of processes of the constitution and emergence of values, e.g. in his book on *The Genesis of Values* (2001). Hans Joas then pursued an analysis of ways in which value commitments are consolidated and contested on a collective level as well as an analysis of norm-guided actions. His major study of this type had a focus on the emergence of notions of human rights over long periods of time and in different contexts. This work was presented in a major volume on *The Sacredness of the Person: A New Genealogy of Human Rights*.

The book stimulated a dialogue between scholars in social theory and in legal theory. It also provided an example of how universalistic claims, inherent in notions of human rights, are not specific to a particular, occidental, tradition but might be arrived at from a starting point in different cultural, societal and religious traditions. With this project, Hans Joas approached issues that had preoccupied Ernst Troeltsch in his efforts to discern pathways whereby human agents from different societal and religious backgrounds, might articulate a commitment, expressed in universalistic terms.

This research programme had also links to Joas publications on the cultural values of Europe and on world religions and on the possibilities to extend an action-based analysis to processes of global change. With this step, Hans Joas once again touched upon themes taken up by Troeltsch, Weber and other scholars in the period of reconstruction of European social thought in the late nineteenth and early twentieth centuries.

Hans Joas' contributions in this field extend and deepen a historical understanding of the role of human action in the constitution of institutions.

They also highlight links between human action and experiences of a transcendental nature. Thus, we arrive at the core of what was at stake, at the time of reconstruction of social thought, in debates a hundred years ago about world religions and world history.

In his book, *The Power of the Sacred: An Alternative to the Narrative of Disenchantment* (German original 2017; English translation 2021), Hans Joas has chosen to focus on these themes and to outline an alternative to Max Weber's writings on disenchantment. However, there is an almost equally extensive and intensive engagement with the concepts of secularization, rationalization and modernization. There is also a treatment of a range of other concepts, not least those of differentiation, socialization and ritual as well as a discussion of the thesis of the Axial Age and of other historical, theological and sociological categories, including the concept of power.

Hans Joas outlines a conception of the sociology of religion that draws on classic works by Ernst Troeltsch and Max Weber but that also goes beyond these works. In particular, Joas proposes a new interpretation of Max Weber's conception of a sociology of religion.

This interpretation is profoundly critical. He states that with Weber's use of concepts that assign magical properties to religious categories, not least to the sacraments of the Catholic Church, a meaningful dialogue about religion and society between believers and non-believers becomes preempted. Furthermore, Joas argues that Weber's concept of Disenchantment entails that there is no other way to a modern capitalist economy than that of an inner-worldly asceticism. This, Joas implies is an unwarranted simplification.

Over a sequence of years, Hans Joas has outlined key requirements of a sociology of religion. In this ambition, Hans Joas is similar to the senior scholar in the previous generation with whom he worked most closely, namely Robert Bellah. He has proposed a rich conceptual variety for the study of human action and human institutions. Wars and other catastrophic events may occur. However, there is also a potential, despite all differences, for human beings to articulate interpretations of values that are respectful of the sacredness of the person and that may jointly be constitutive of non-hegemonic common interpretations.

It is not an exaggeration to state that in his recent works, Hans Joas has become ever more explicit in his criticism of Max Weber. At the same Hans Joas' remains inspired by the works of Max Weber's friend Ernst Troeltsch. Joas' oeuvre comes close to realizing visions outlined by Troeltsch in the five lectures that he received an invitation in the spring of 1920 to give in in London, Oxford and Edinburgh and that were published in book format only in 1924, i.e. the year after Troeltsch passed away.

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Laudatio G.Wanner

Marnix Van Daele

It is a pleasure and an honor to me to introduce Gerhard Wanner as the winner of the Sarton Medal 2019-2020 of the Faculty of Sciences of Ghent University. Gerhard Wanner is an authority in the field of numerical analysis of differential equations with a great passion for the history of mathematics.

Gerhard is born in 1942 in Innsbruck in Austria, and he grew up in Tirol. As his mother was Dutch, he not only learned German, but also some Dutch. I'm pretty sure you will notice this in his talk.

He studied mathematics at the University of Innsbruck and in 1965 he obtained his PhD under the guidance of his advisor Wolfgang Gröbner, for mathematicians a well-known name associated to the so-called Gröbner-bases used in algebraic geometry.

The title of the dissertation (translated into English) was "A contribution to the numerical treatment of boundary value problems of ordinary differential equations". In 1969 he obtained his Habilitation-degree, again at the University of Innsbruck. As a young assistant he met a bright student there: Ernst Hairer. Ernst became Gerhard's PhD student and it would be the start of a very long, extremely successful, close collaboration until Gerhard's retirement in 2007. By the way, Ernst Hairer is the father of Martin Hairer, who has won the Fields medal in 2014.

Until 1973 Gerhard taught in the German language in Innsbruck, but then he was appointed at the University of Geneva in Switzerland, where the teaching language is French. Although Gerhard didn't speak a word French at that time, he managed with the help of friends and colleagues who translated the German texts he prepared into French, to teach in French from the very start of his appointment in Geneva.

Nevertheless, moving to Geneva turned out to be a very good choice. After a few years, in 1976, he became full professor and in 1985 also Ernst Hairer was appointed in Geneva. Other excellent colleagues later joined the numerical analysis school that Gerhard thus started.

As I already mentioned, the collaboration of Gerhard and Ernst was extremely successful. In 2003 they were awarded the Peter Henrici Prize for original contributions to applied analysis and numerical analysis and/or for exposition appropriate for applied mathematics and scientific computing.

Together they have written several seminal papers, and they co-authored a two-volume monograph on the *Numerical solution of ordinary differential equations*. For many researchers these two books were like the bible: a first volume from 1987, the Old Testament, on *nonstiff problems* and in 1991 a second-part, the New Testament, on *stiff problems and differential-algebraic equations*. These books stood, so to speak, on the nightstand next to the beds of many young researchers.

In 2002 they published, together with Christian Lubich, a former PhD-student of Ernst Hairer from Innsbruck and an eminent researcher too – a third very popular part: now the focus was on *Geometric Numerical Integration*.

Further, Gerhard co-authored two undergraduate textbooks: *Analysis by its History* from 2001 (with, again, Ernst Hairer as co-author) and in 2012 *Geometry and its History* with Alexander Ostermann, again from Innsbruck. Both books give historically oriented explanations of mathematics.

In 2015, Gerhard Wanner received from SIAM (Society for Industrial and Applied Mathematics) The George Pólya Prize for Mathematical Exposition. This prize, established in 2013, is awarded every two years to an outstanding expositor of the mathematical sciences. In a press release, SIAM motivated their choice as follows: "*Wanner is being honored primarily for the five books he has co-authored. They display deep mathematics, presented with elegance, enthusiasm, scholarship, and much history. These books have uniquely delineated numerical ODEs (especially stiff equations) and geometric integration and created a historical perspective for the teaching and understanding of analysis and geometry*."

During his active career, Gerhard also held several managerial and administrative functions, inside as well as outside of his university. He was for instance secretary, vice-president and president of the Swiss Mathematical

Society, he was chairman of the "section VII" of the Académie des Sciences Naturelles (2000-2005), and he was elected president of the Scientific Committee of the ICIAM conference in 2007 in Zurich, just to name a few.

Gerhard preferred scientific research above these managerial functions. In the last slide of his "farewell lesson" in 2007 he wrote: "... *La grande déception de ma vie: n'avoir jamais du refuser de devenir Doyen ou Vice-Doyen*".

After retiring, Gerhard continued working and in particular he focused on giving historical overviews of the works of well-known mathematicians such as Euler, Kepler, Newton, Leibniz, Bernoulli, Lagrange, etc. In these talks he starts from old ideas, he relates them to even older ideas of Ancient Greek mathematicians, and integrates modern ideas or applications in his talks. This will also be the case in the presentation he gives today. His talks and his research on the history of mathematics was very much appreciated and often colleagues have asked him to participate on their research on the history of specific topics or specific personalities.

I think, meanwhile, that it is clear that Gerhard is a highly respected mathematician that has had a bright scientific career, first as a numerical analyst, later as a mathematical historian.

But above all, Gerhard is well-respected because he is a very charming, humorous, humble person. When I asked him for a cv in order to nominate him for the Sarton Medal, he wrote me that he did not have a complete cv and this was his explanation: "*My problem is, that I am, since nearly half a century, a happy and satisfied professor in Geneva, especially after the arrival of Ernst Hairer in 1985, without any desire for a better situation. Therefore I don't have any list of publications ready, neither any impressive cv. The only texts I have are texts which, one year or another, some dean asked me to furnish in order to justify my salary.*"

Anyone who knows Gerhard also knows his love for nature, In particular his love for the mountains. He took many visiting colleagues into the mountains for hiking or skiing. He even has a list of scientific contacts on his website, including the altitude at which this contact took place. The highest scientific contact is 4807 m above the sea … together with, of course, Ernst Hairer. The lowest height is 2 meters below sea level: this was a conference in Amsterdam (100 years of Runge-Kutta methods in 1995) I attended too. Probably this was the first time I met Gerhard.

Gerhard,

I am very pleased that you responded positively to my idea three years ago to nominate you for the Sarton Medal of the Faculty of Science, and that – despite all the corona troubles – you have travelled to Ghent to receive the Sarton Medal.

Once more, I look forward, together with the audience, to your talk.

250 years of Euler-Fourier

Gerhard Wanner[1]

"Alors M. Lebesgue, vous faites de l'histoire des sciences ?"

"Non, Mademoiselle, je fais de la science." *(Témoignage de L. Félix)*

A quarter of a millennium ago, in 1768, Leonhard Euler published the first volume of his monumental treatise on lntegral Calculus [11]; in the same year Joseph Fourier was born, the father of the Heat Equation [15] and principal promoter of the Fourier Series for its solution.

We start with a modern problem, due to Chris Budd and John Stockie [6], describing how water penetrates porous media. Asymptotic properties of this problem posed a challenge. We move down the historical sources for methods which allow the computation of the required asymptotic formulas with high precision.

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1. Diffusion in porous media

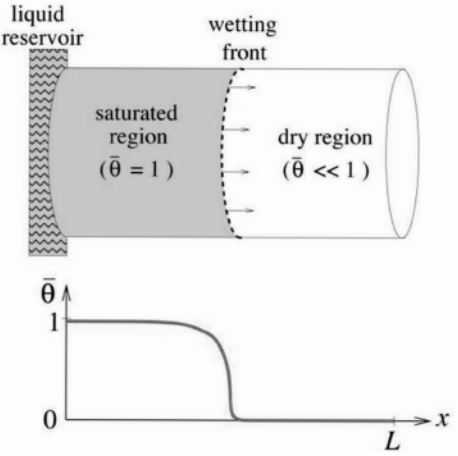


Figure 1: Pictures from Budd-Stockie p. 6

We suppose to have a porous body (see Figure 1), initially dry, which has been brought at the side $x=0$ instantly into contact with a liquid reservoir. We denote by $\theta(x, t)$ the quantity of saturation at the position x and time t, normalised such that $0 \leq \theta(x, t) \leq 1$ (0 for maximally dry and 1 for maximally saturated). Budd and Stockie [6] consider for this function the partial differential equation

$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial x}\left(Ce^{\beta\theta} \cdot \frac{\partial \theta}{\partial x}\right) \qquad (C \text{ and } \beta \qquad (1)$$

together with

$$\theta(x,0) = 0 \ \ (\text{for all } x)\,, \qquad \theta(0,t) = 1 \ \ (\text{for all } t)\,, \qquad (2)$$

because such "an exponential diffusion beginning provides a good fit with measured data". We observe in Fig. 1 that this situation creates a wetting front.

Following ideas from Fourier (see (23) below) and the book of Crank [10], Budd and Stockie reduce this problem to a simple looking ordinary differential equation (29), which hides great numerical difficulties. If this equation is solved from the initial values $y(0) = 1$, $y'(0) = -\gamma$, the solution creates a wetting front at a point x^* (see the precise definition (35) below) and allows the computation of the value β in (1) (see definition (34)).

The challenge is to determine these physically interesting values x^* and β as functions of this initial value γ. Amodio, Budd, Koch, Settanni and Weinmüller [1] derived a particular multi-step method of order 4 and 8 with step-size control for this task and arrived at the asymptotic expansions

$$x^* = \frac{1}{\gamma} + \frac{1}{2\gamma^3} + \frac{11}{12\gamma^5} + \frac{2.96}{\gamma^7} + \ldots \qquad \beta = \gamma^2 + \frac{1}{2} + \frac{1}{12\gamma^2} + \frac{0.089}{\gamma^4} + \ldots \qquad (3)$$

for large values of γ. We show here, with methods right out of two and a half centuries old Euler's Integral Calculus [11], that one can obtain the expansions

$$x^* = \frac{1}{\gamma} + \frac{1}{2\gamma^3} + \frac{11}{12\gamma^5} + \frac{403}{144\gamma^7} + \frac{33533}{2880\gamma^9} + \frac{1743739}{28800\gamma^{11}} + \frac{272569189}{725760\gamma^{13}} + \frac{304760447347}{112896000\gamma^{15}} + \frac{8063058661456217}{365783040000\gamma^{17}} + \ldots \qquad (4)$$

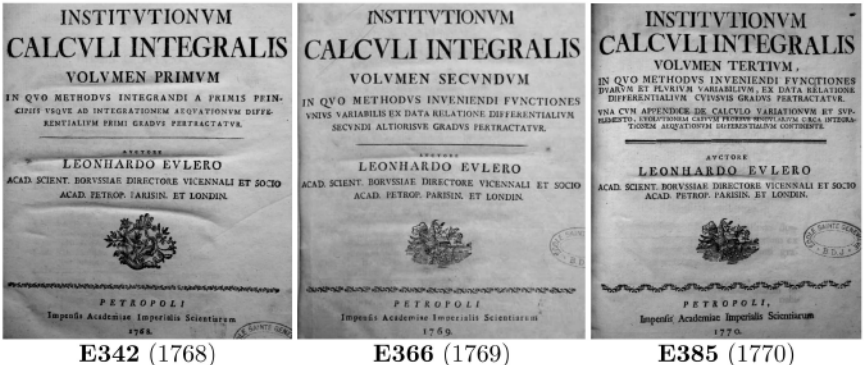
$$\beta = \gamma^2 + \frac{1}{2} + \frac{1}{12\gamma^2} + \frac{13}{144\gamma^4} + \frac{743}{4320\gamma^6} + \frac{1443}{3200\gamma^8} + \frac{26674933}{18144000\gamma^{10}} + \frac{5742013211}{1016064000\gamma^{12}} + \frac{31758274705487}{1280240640000\gamma^{14}} + \ldots . \qquad (5)$$

In particular, the constants in the last terms of (3) should be 2.80 and 0.090 (see equation (46) below), respectively.

2. Euler's Integral Calculus

"Ergo & horum Integraliæ æequantur,..." *(Jac. Bernoulli [3])*

"Quoique le nom d'Euler soit attaché à presque toutes les théories importantes du Calcul intégral,..." *(Legendre)*



E342 (1768) **E366** (1769) **E385** (1770)

Figure 2: Euler's *Institutiones Calculi Integmlis* (courtesy Ph. Henry)

Integral Calculus is implicitly contained in many classical works, in particular Archimedes [2], Fermat [14], Cavalieri [8], [9] (for an edition of a "inédite" note of Lagrange on Cavalieri's method, see [20]), and Newton [22]. lt received its modern notation from Leibniz [21] and its name together with many applications from the Bernoulli Brothers [3] (see Fig. 3) and [4]. The first great treatise were Euler's *Institutiones Calculi Integralis*, published a quarter of a millennium ago in three volumes [11] (E342[2] , 1768) [12] (E366, 1769) and [13] (E385, 1770, see Figure 2). E342 and E366 form a unity with paragraphs numbered consecutively from §1 to §1275, organised as follows:

E342 ***differentialium primi gradus*** (§1-§705: first order differentials).

Sectio prima (§40-§396: determination of integrals $\int f(x)\,dx$). From this section we shall use the formulas

$$\int \frac{a\,dx}{x} = a\log x + C \qquad (6)$$

(§47) and

$$\int \frac{a^x dx}{x^4} = C - \frac{a^x}{3x^3} - \frac{a^x la}{3.2x^2} - \frac{a^x (la)^2}{3.2.1x} + \frac{(la)^3}{3.2.1}\int \frac{a^x dx}{x}$$

$$\int \frac{e^x\,dx}{x} = \frac{e^x}{x} + \frac{e^x}{x^2} + \frac{2e^x}{x^3} + \frac{2\cdot 3e^x}{x^4} + 2\cdot 3\cdot 4\int \frac{e^x\,dx}{x^5} \qquad (7)$$

(§225), which, when read backwards (second line), gives an asymptotic expansion of the "exponential integral", which has no elementary primitive.

Sectio secunda (§397-§667: first or differential equations $dy = V(x, y)\,dx$).

This section starts right away (§397) with the method of separation of variables

DE
SEPARATIONE VARIABILIVM.

for equations of the type

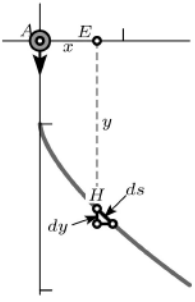
$$dy = f(x)\cdot g(y)\cdot dx \quad \Rightarrow \quad \frac{dy}{g(y)} = f(x)\,dx \quad \Rightarrow \quad \int \frac{dy}{g(y)} = \int f(x)\,dx + C\,. \qquad (8)$$

The first historic use of this method was Jakob Bernoulli's solution of a challenge of Leibniz[3] , in order to defend his calculus against the attacks of the "Cartesiens" in France (see Fig. 3). The problem was to find the curve *AH* such that a body, falling under gravitation from *A*, hence with increas-

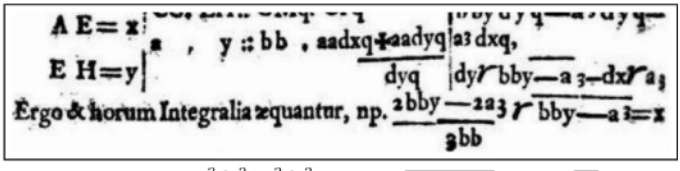
[2] The "E" stands for Gustaf Eneström, who established in 1910 and 1913 the catalogue of Euler's works from El to E866.

[3] 1687 and 1689, "L'Analyse de Messieurs les Cartesiens le donnera peut-être aisément"

ing velocity proportional to $\sqrt{y}$, when gliding on this curve, has constant vertical velocity. Thus $\frac{ds}{dy}$ should be proportional to $\sqrt{y}$.



Jakob Bernoulli, AE 1690: "Linea isochrona":



$$a : y = b^2 : \frac{a^2dx^2+a^2dy^2}{dy^2} \Rightarrow dy\sqrt{b^2y-a^3} = dx\sqrt{a^3}$$

$$\frac{2b^2y-2a^3}{3b^2}\sqrt{b^2y-a^3} = x\sqrt{a^3}+C$$

Figure 3: Jakob Bernoulli's solution of Leibniz's challenge by separation of variables; first publication of the term "Integral"

Euler's numerical method. After many paragraphs on the solution of differential equations by analytic formulas (most of which are inventions of Euler), Euler then started in §650 with methods for their numerical solution (*"proxime integrandi"*). The first of these (see Figure 4), grand-grand-grand mother of a good deal of todays numerical calculations by the computers of the World, is written today as

$$y_{i+1} = y_i + (x_{i+1} - x_i) \cdot V(x_i, y_i)\,, \qquad (9)$$

starting from an initial value $x_0 = a$, $y_0 = b$. Euler understood that the method worked, despite of all the errors which were introduced at every step, and demonstrated its use at the Riccati equation $\frac{ds}{dy} = x^2 + y^2$, which is one of the simplest equations without analytic solution. See Figure 6 (left) for an illustration; here the initial value $(-1.5, y_0)$ has been chosen in such a way that the exact solution should pass through the origin (0,0). The first rigorous convergence proof of Euler's method was given by Cauchy [7].

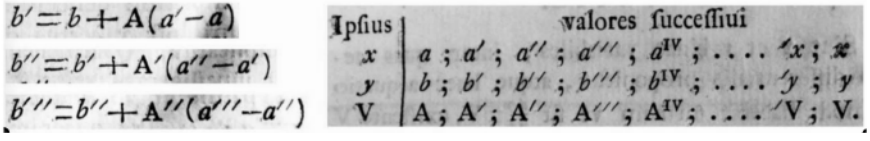


Figure 4: Euler's method (9) in [11, §650]

Higher order methods (§656). Observing that (9) represents the first two terms of the Taylor series of the solution through (x_i, y_i), one can *magis perficere* the method by replacing it by, e.g.,

$$y_{i+1} = y_i + (x_{i+1} - x_i) \cdot y'(x_i) + \frac{(x_{i+1} - x_i)^2}{2!} \cdot y''(x_i) \qquad (10)$$

after computing $y''(x_i)$ through *continuo differentiando*

$$y''(x) = \frac{d}{dx}y'(x) = \frac{d}{dx}V(x, y(x)) = \frac{\partial V}{\partial x} + \frac{\partial V}{\partial y} \cdot y'(x) = \frac{\partial V}{\partial x} + \frac{\partial V}{\partial y} \cdot V \quad \text{etc.}$$

See Euler's computations (§662) of these derivatives for the equation $y' = x^2 + y^2$ in Figure 5 and the corresponding numerical results in Figure 6 (middle for order 2, right for order 3).

662. *Aequationis differentialis* $\partial y = \partial x\,(x x + y y)$ *integrale completum proxime investigare.*

Cum hic sit $\frac{\partial y}{\partial x} = V = x x + y y$, erit continuo differentiando

$$\frac{\partial \partial y}{\partial x^2} = 2x + 2xxy + 2y^3 \text{ et}$$

$$\frac{\partial^3 y}{\partial x^3} = 2 + 4xy + 2x^4 + 8xxyy + 6y^4$$

$$\frac{\partial^4 y}{\partial x^4} = 4y + 12x^3 + 20xyy + 16x^4y + 40xxy^3 + 24y^5$$

$$\frac{\partial^5 y}{\partial x^5} = 40x^2 + 24y^3 + 104x^3y + 120xy^3 + 16x^6 + 136x^4y^2 + 240x^2y^4 + 120y^6.$$

Figure 5: Euler's computation of the derivatives for Riccati's equation

"Automatic differentiation" (§663). Many of the programmers of the first "high-speed automatic machines" invented algorithms which avoid differentiations for the computation of such Taylor terms (incomplete list: J.F. Steffensen 1956, Richtmyer 1957, Miller-Hurst 1958, A. Gibbons 1960, E. Rabe 1961, I. Mennig 1964, E. Fehlberg 1964, Shanks 1964, G. Wanner 1965, W. Gautschi 1966, DepritZahar 1966, Leavitt 1966, R. Moore 1966, Chiarella-Reichel 1968,...). We demonstrate the method at the example $y' = x^2 + y^2$: Given (x_0, y_0), set

$$y(x_0 + h) = y_0 + hy_1 + h^2y_2 + h^3y_3 + h^4y_4 + \dots \qquad (11)$$

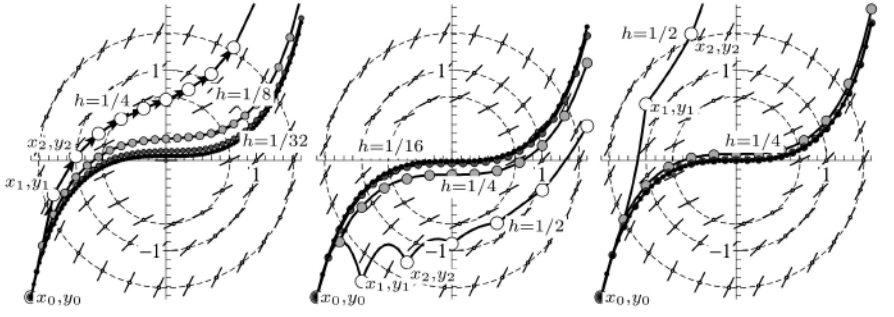


Figure 6: Euler's methods of orders 1,2,3 for Riccati's equation

with unknown coefficients $y_1, y_2, y_3,...$ [4]. Then

$$\begin{array}{lllllll} \text{derive:} & y' = y_1 & +2y_2h & +3y_3h^2 & +4y_4h^3 + \dots & & \\ \text{expand:} & x^2 = x_0^2 & +2x_0h & +h^2 & & & (12) \\ \text{expand:} & y^2 = y_0^2 & +2y_1y_0h & +(2y_0y_2 + y_1^2)h^2 & +2(y_0y_3 + y_1y_2)h^3 + \dots & & \end{array}$$

and compare the coefficients of h^0, h^1, h^2, h^3 ,... to obtain the following formulas which allow the recursive computation of $y_1, y_2, y_3, y_4,...$:

$$y_1 = x_0^2 + y_0^2,\ 2y_2 = 2x_0 + 2y_1y_0,\ 3y_3 = 1 + 2y_0y_2 + y_1^2,\ 4y_4 = 2y_0y_3 + 2y_1y_2, \dots$$

See e.g., [17, p. 47] how this idea extends to a general algorithm. Nobody realised at that time that the same method was already proposed by Euler in §663 (*"sine differentiatione"*, see Figure 7).

$$\begin{array}{l} \alpha = a\,a + b\,b,\ 2\,\beta = 2\,\alpha\,b + 2\,a,\ 3\,\gamma = 2\,\beta\,b + \alpha\,\alpha + 1, \\ \quad 4\,\delta = 2\,\gamma\,b + 2\,\alpha\,\beta,\ 5\,\varepsilon = 2\,\delta\,b + 2\,\alpha\,\gamma + \beta\,\beta \\ \quad 6\,\zeta = 2\,\varepsilon\,b + 2\,\alpha\,\delta + 2\,\beta\,\gamma,\ \text{etc.} \end{array}$$

Figure 7: Euler's algorithm "sine differentiatione" for Riccati's equation

E366, higher order differential equations (§706-§1275).

Sectio prior (§706-§1099; second order equations, *aequationum differentialium secundi gradus duas tantum variabiles involventium*). Euler starts by introducing the notations

$$p = \frac{dy}{dx}, \quad q = \frac{dp}{dx} \quad \text{hence} \quad q = \frac{d^2y}{dx^2} \qquad (13)$$

and calls any relation among *x, y, p, q* a second order differential equation. We are interested here in the particular case (Chap. II, §769) where the variable *x* is absent *("variabilis x ipsa in ea desit")*. Then the relation

$$q = \frac{dp}{dx} = \frac{dp}{dy} \cdot \frac{dy}{dx} = p \cdot \frac{dp}{dy} \qquad \text{erit } q = \frac{p\,dp}{dy} \qquad (14)$$

allows to reduce such a second order autonomous equation for *y(x)* into a first order equation for *p(y)*. Euler gives six examples, from Exemplum 1 (§775) to Exemplum 6 (§789), none of which is very simple. We add to these an Exemplum 7 from a relatively simple question in celestial mechanics, the movement of a body along a straight line to the center of a planet under Newton's law of gravitation (*y* distance from the center, *R* the planet's radius, *g* gravitational acceleration on the surface, $K = gR^2$)

[4] By using the notations $y_1, y_2, y_3,...$ for the higher derivatives, we suppress the *i* for the step number in equations (9) and (10), in order to avoid double indices. We also use the standard abbreviation $h = x_i+1 - x_i$ for the step-size.

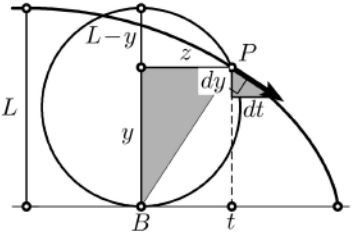
$$\frac{d^2y}{dt^2} = -\frac{K}{y^2} \quad \Rightarrow \quad p\cdot\frac{dp}{dy} = -\frac{K}{y^2} \ \text{(sep.)} \ \ p\cdot dp = -K\frac{dy}{y^2} \ \text{(int.)} \ \ \frac{p^2}{2} = \frac{K}{y} + C\,. \quad (15)$$

For determining C, the constant of integration, we suppose that at a certain distance L the velocity p is zero, which gives for p as function of y

$$\frac{p^2}{2} = \frac{K}{y} - \frac{K}{L} \quad \Rightarrow \quad p = \pm\sqrt{2K}\sqrt{\frac{1}{y} - \frac{1}{L}} = \pm\sqrt{\frac{2K}{L}}\sqrt{\frac{L-y}{y}} = \frac{dy}{dt}\,. \qquad (16)$$

The last equation is a differential equation for computing y as function of t, which we have to separate and integrate a second time:

$$-\int\sqrt{\frac{y}{L-y}}\,dy = \sqrt{\frac{2K}{L}}\int dt \qquad (17)$$



As discovered by Johann Bernoulli (see [4, Lectio XVII]), the solution is, except for the sealing factor $\sqrt{\frac{2K}{L}}$, a cycloid created by a rolling circle of diameter L. To see this, use that the tangent in P is perpendicular to PB (Huygens in 1673), $dt = \frac{y}{z}\,dy$ (from two similar triangles) and $z = \sqrt{y(L-y)}$ (Eucl. II.14). Euler, in E342, in particular "Problema 8" (§99), gives a general method for the class of such *"formularum irrationalium"* by using the substitution $z^2 = \frac{y}{L-y}$, $y = \frac{z^2L}{1+z^2}$, $dy = \frac{2Lz}{(1+z^2)^2}\,dz$, which turns the *formula* into a rational one.

Numerical computation of second order equations. By far not all second order equations are reducible to first order, if so, not all obtained first order equations are separable or solvable by any other idea, if so, not all integrals have then elementary primitives, if so, as in the foregoing example, the analytic expressions can be complicated and often give us t as function of y and not the inverse as required. Therefore, in §1082 (Problema 137), Euler starts to *principia explicare* the solution of second order equations *per approximationes*.

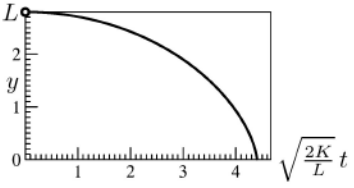
From the observation, that a relation between x, y, p, q (see (13)) determines $q = \frac{d^2y}{dx^2}$ as function $F(x, y, \frac{dy}{dx})$,we need, for uniqueness, at some position x_0 initial values y_0, p_0 given for both y and p. Therefore, we have to update both of them along the computation. This gives, instead of (9):

$$\begin{aligned} \frac{dy}{dx} &= p \\ \frac{dp}{dx} &= F(x,y,p) \end{aligned} \quad \Rightarrow \quad \begin{aligned} y_{i+1} &= y_i + (x_{i+1} - x_i) \cdot p_i \,, \\ p_{i+1} &= p_i + (x_{i+1} - x_i) \cdot F(x_i, y_i, p_i) \end{aligned} \qquad (18)$$

$y = b + c\omega \,;\; p = c + F\omega$

Exemplum 7. If we compute with this method directly equation (15) with $K = 1$ and initial values $y_0 = L = 2.8$, $p_0 = 0$, we obtain, using some lines of code with $\Delta x = 0.001$ in 5208 steps, the values of y with a precision of three digits for any value of t (i.e. Joh. Bernoulli's scaled cycloid):

$$\begin{aligned} y_{i+1} &= y_i + \Delta x \cdot p_i \,, \\ p_{i+1} &= p_i - \Delta x \cdot \frac{1}{y_i^2} \end{aligned} \qquad (19)$$



E385 ([13], on partial differential equations). Some twenty years after the discovery of the first partial differential equation (for the vibrating string) by d'Alembert, Euler wrote this entire book on PDEs, mainly series expansions and coordinate transformations for elliptic and hyperbolic equations. Parabolic equations were yet unknown. This brings us to Fourier.

3. Fourier's Heat Equation

"Son analyse... laisse encore quelque chose à désirer, soit relativement à la généralité, soit même du coté de la rigueur"

(Laplace, Lagrange, Legendre; cited from H. Burkhardt, Enzykl. d. math. Wiss. Bd. 2-1-2, p. 957)

Joseph Fourier (1768-1830)[5] took part in Napoleon's special operation in Egypt and was then installed as *Préfet de l'Isère*, far away from any scientific centre, in Grenoble. It was here that he discovered his Heat Equation and a clear understanding of trigonometrie series for its solution. In December 1807 he presented a first manuscript to the *Académie* in Paris, which encountered severe criticism (see the quotation) and was only published in full length more than 160 years later (see [16]). In 1817 Fourier became *académicien* himself and in 1822 *secrétaire perpétuel*. Now, the way was free for the publication of the enlarged version of his work [15],

[5] See [19] for a tribute to Fourier.

exactly 200 years ago. However, the manuscript from 1807 gives the clearest insight in the creation of his theory. He proceeded in two steps:

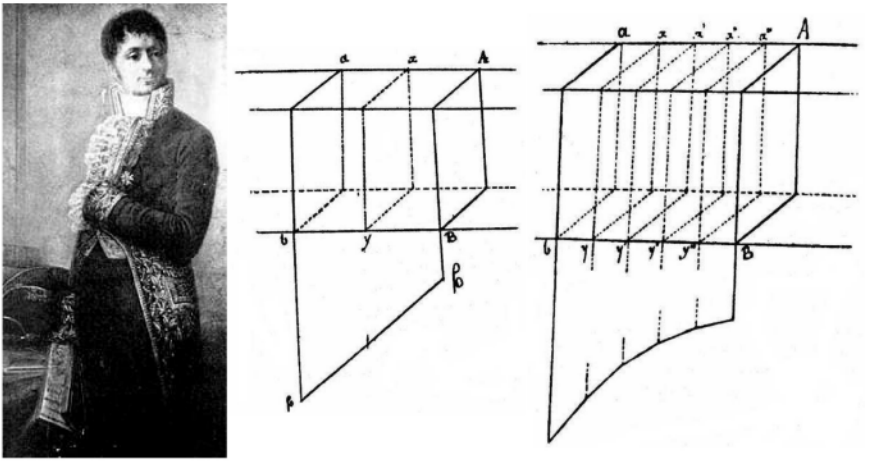


Figure 8: discovery of Fourier's equation (middle and right: from the 1807 ms.)

First he imagined the temperature in equilibrium in a rod inside a slice *(tranche)* between two faces *ab* and *AB* (see Figure 8, middle) with two temperatures v_1 (in the figure denoted α) and v_2 (denoted β). Then the temperature inside this slice would be a linear function $v = v_1 + (x - x_1) \cdot \frac{v_2 - v_1}{x_2 - x_1}$ creating a heat flow from warm to cold with quantity

$$-KS\left[\frac{v_2 - v_1}{x_2 - x_1}\right] \quad \text{or} \quad -KS\,\frac{\Delta v}{\Delta x} \qquad (20)$$

where K is the *"conductibilité intérieure"* and S is the area of the faces.

In the second step, he imagined a rod (see Figure 8, right) heated on one side and in addition cooled by the surrounding air of temperature 0. This rod is split up into several slices. For each of these, say between x_i and x_i+1, we apply equation (20) on both faces, which are thought to be infinitely thin *(tranche infiniment petite)*. Then the gain of heat in this slice is the difference of heat entering through one face and leaving through the other:

$$\text{heat gain} = KS\left[\frac{dv_{i+1}}{dx} - \frac{dv_i}{dx}\right] - h\ell\,dx \cdot v\,. \qquad (21)$$

Here, the last term represents the heat lost through the exterior face of area $l\,dx$ proportional to the temperature v. This gain of heat will give rise to an increase of temperature $\frac{\partial v}{\partial t}$ inside the slice, when this gain is divided by a constant C *("ce qu 'il faut de la chaleur pour faire passer l'unité de poids*

de la matière (...) de la température 0 à la température 1"), *D (la densité)*, and by the volume *S dx*. We so obtain the famous equation (to the right in Fourier's handwriting from 1807)

$$\frac{\partial v}{\partial t} = \frac{K}{CD}\frac{\partial^2 v}{\partial x^2} - \frac{h\ell}{CDS}\,v \qquad \frac{\partial v}{\partial t} = \frac{K}{C\cdot D}\frac{\partial^2 v}{\partial x^2} - \frac{h\ell}{C\cdot DS}\,v \qquad (22)$$

The factor $\frac{K}{CD}$ is often normalised to 1 and there is no exterior cooling term. From here on follow long chapters about the solution of this equation in various dimensions and geometries, leading to trigonometrie series. See [19] for more explanations.

Heat flow in infinite domains. Going beyond his manuscript from 1807, Fourier extended in [15, Chap. IX, p. 459] trigonometrie series to *"une ligne infinie"* and arrived at, what is called today, the *Fourier Transform*. After long calculations, he found simple particular solutions of

$$\frac{\partial v}{\partial t} = \frac{\partial^2 v}{\partial x^2} \quad \text{of the form} \quad v(x,t) = \varphi(\xi) \quad \text{with} \quad \xi = \frac{x}{2\sqrt{t}} \qquad (23)$$

depending on a function φ of only one variable. Once this idea found, it is easy to verify, using the chain rule, that

$$\begin{aligned} \frac{\partial v}{\partial t} &= \frac{d\varphi}{d\xi}\frac{\partial \xi}{\partial t} = \varphi'(\xi)\cdot\frac{-x}{4t^{3/2}} = -\varphi'(\xi)\cdot 2\xi\cdot\frac{1}{4t} \\ \frac{\partial v}{\partial x} &= \frac{d\varphi}{d\xi}\frac{\partial \xi}{\partial x} = \varphi'(\xi)\cdot\frac{1}{2\sqrt{t}}\,, \qquad \frac{\partial^2 v}{\partial x^2} = \varphi''(\xi)\cdot\frac{1}{4t}\,. \end{aligned} \qquad (24)$$

Comparing the two formulas, we see that equation (23) is equivalent to

$$\varphi'' = -2\xi\cdot\varphi'\,. \qquad (25)$$

Here, *"variabilis y non ingrediatur"* (E366, §750), therefore we set $p = \varphi'$ and obtain $\frac{dp}{d\xi} = -2\xi\cdot p$. Separation of variables leads to $p = \varphi' = c\cdot e^{-\xi^2}$. If we want the same boundary values as in (2), i.e., if $\varphi(0) = 1$ and $\lim_{\xi\to\infty}\varphi(\xi) = 0$, we obtain

$$\varphi(\xi) = 1 - \frac{2}{\sqrt{\pi}}\int_0^\xi e^{-\tau^2}\,d\tau\,. \qquad (26)$$

The corresponding solutions *v(x,t)* for various values of *t* are drawn in Figure 9. These are the solutions of equation (1) for $C = 1$ and $\beta = 0$. For the general case with C and β arbitrary, the equation corresponding to (25) will be more challenging.

4. Numerical solution of problem (1)

Variable diffusion coefficient. It was realised around 1890 (see [24, p. 142 and the footnote therein]) that in many diffusion processes the constant K in equation (21) is actually a function $k(v)$ depending on the concentration v. This means that one has $S[k(v_{i+1})\frac{dv_{i+1}}{dx} - k(v_i)\frac{dv_i}{dx}]$ instead of (21), which leads to the equation

$$\frac{\partial v}{\partial t} = \frac{\partial}{\partial x}\Big(k(v)\frac{\partial v}{\partial x}\Big)\,. \qquad (27)$$

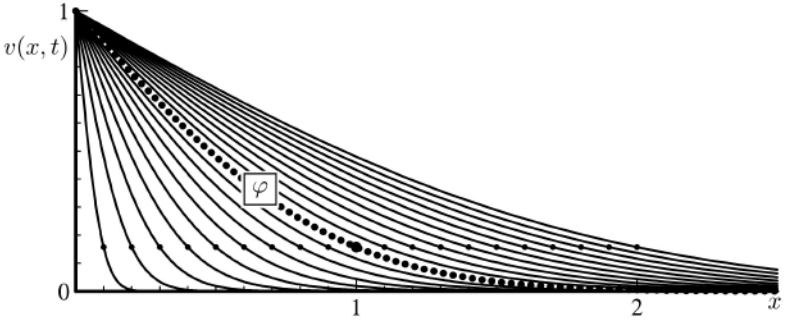


Figure 9: Solutions of (23) for $2\sqrt{t}$ = 0.1, 0.2, 0.3, ..., 1, ..., 2

As observed by L. Boltzmann [5], this equation can be reduced for infinite domains, similar to the transformation (24), to

$$-\varphi'(\xi)\cdot\xi = \frac{d}{d\xi}\Big(k(\varphi)\cdot\varphi'(\xi)\Big)\,, \quad \text{where} \quad v(x,t) = \varphi(\xi)\,, \quad \xi = \frac{x}{\sqrt{2t}}\,. \qquad (28)$$

similar to equation (25).

Exponential diffusion coefficients. In many applications, for example diffusion in liquids or alloys, but also diffusion in porous media, the coefficient $k(v)$ is the exponential function $k(\varphi) = e^{\varphi}$ (see [23] and the "Diffusion Bible" [10, §7.2.4]). But for programmers of "high-speed electronic devices" in the Fifties, the exponential function inside the differential equation was a nasty object. This suggests the substitution

$$y(\xi) = e^{\varphi(\xi)} \quad \text{for which (28) becomes} \quad \boxed{y\cdot y'' = -\xi\cdot y'} \qquad (29)$$

because $y'(\xi) = \varphi'(\xi)\cdot e^{\varphi(\xi)}$, such that (28) means $-\varphi'(\xi)\cdot\xi = \frac{d}{d\xi}y'(\xi) = y''(\xi)$ which becomes (29) by multiplication with y.

This *relationen inter quantitates x, y, p, q*, in Euler's notation $y\cdot q = -x\cdot p$, one of the simplest where none of the four is *ipsa in ea desit*, is the fundamental

tool for our study. It can numerically be very challenging, because it is non-linear and, for $y \to 0$, becomes a "stiff equation". Crank filled an entire page of his book [10, p. 383] with numbers tabulating various solutions of (29).

The porous media problem of Budd and Stockie. For equation (1) Budd and Stockie suggest the transformation

$$\theta(x,t) = \varphi(\xi)\,, \quad \xi = \frac{x}{\sqrt{2tCe^{\beta}}} \quad \Rightarrow \quad -\varphi'(\xi)\cdot\xi = \frac{d}{d\xi}\left(e^{\beta(\varphi-1)}\cdot\varphi'(\xi)\right), \qquad (30)$$

instead of (28). From here we obtain equation (29) if we put

$$y(\xi) = e^{\beta(\varphi(\xi)-1)} \quad \Leftrightarrow \quad \varphi = 1 + \frac{\log y}{\beta}\,. \qquad (31)$$

The clever choice of inserting the factor e^{β} in the definition of ξ in (30) produced the term -1 in the equation for φ in (30) and for y in (31). As a consequence, the initial value for φ originating from (2)

$$\varphi(0) = 1 \quad \text{turns into the initial value} \quad y(0) = 1\,. \qquad (32)$$

In order to start off Euler's machinery (18) from this initial value, we have to insert $F(x,y,p) = -\frac{xp}{y}$[6] and choose an initial value for $p = y'$

$$p_0 = y'(0) = -\gamma \qquad \text{for example} \quad \gamma = 1 \text{ or } \gamma = \sqrt{2}\,. \qquad (33)$$

See the results in Figure 10.

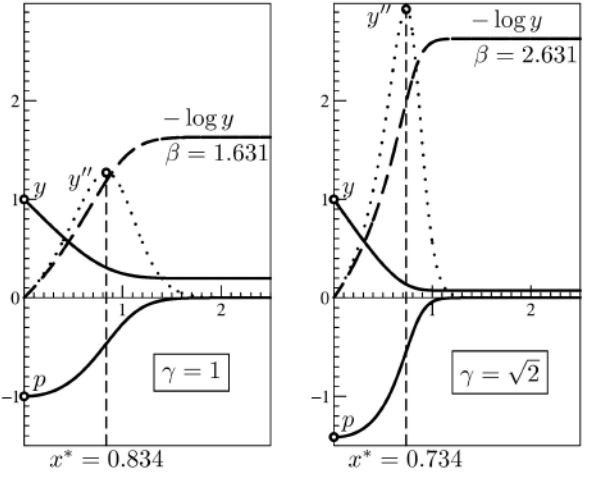


Figure 10: Solutions of (29) for initial values (32), (33), γ = 1 and √2

In the beginning, $p(x)$ starts at -γ with slope 0, hence y decreases along the line l-γx towards 0. For growing x and small y, the equation for p

[6] from here on we use the letter x instead of ξ

approaches the form $p' = -\lambda p$ with $\lambda \approx \frac{x}{y}$ becoming large. This, as Dahlquist understood in 1963, is a typical stiff equation (see e.g., [18, p. 16]). As a consequence, p tends rapidly to 0 and y to a constant y_∞. If we require, from the second boundary condition in (2), that $\varphi_\infty = 0$, we see from (31) that β, the constant in the exponential diffusion coefficient of (1), must be

$$\beta = -\log y_\infty \,. \tag{34}$$

Our second value of interest (describing the position of the "wetting front") is the point x^*, where y, passing from the straight line $1 - \gamma x$ to the straight line y_∞, attains greatest curvature. For this, Budd and Stockie choose the definition

$$y''(x^*) = \max \quad \text{or} \quad p''(x^*) = 0 \quad \text{or} \quad -y + x^2 + xp\big|_{x=x^*} = 0\,, \tag{35}$$

(the last condition is obtained by differentiating the equation for p' and simplifying). For small values of γ, the two values can be computed with high precision by a non-stiff code, for example DOP853 in [17, p. 181f, 481] written by E. Hairer to obtain

$$\begin{array}{lll} \beta = & 1.63050824778 & 2.630857629334 \\ x^* = & 0.83352553144 & 0.734311606447 \end{array} \tag{36}$$

Our challenge is to compute these values for large values of γ and to prove (4) and (5) improving the results in (3).

First: the non-stiff part. In the beginning of the calculation, we use high order Taylor solutions, with the same notations as in (11) and (12),

$$\begin{array}{lll} x = x_0 + h, & y = y_0 + hy_1 + h^2 y_2 + ..., & p = p_0 + hp_1 + h^2 p_2 + ..., \\ & y' = y_1 + 2hy_2 + 3h^2 y_3 + ..., & p' = p_1 + 2hp_2 + 3h^2 p_3 + ... \end{array} \tag{37}$$

for which we obtain, by comparing coefficients of $h^0, h^1, h^2, h^3, ...$ successively

$$\begin{array}{lll} & y' = p & p' \cdot y = -x \cdot p \\ \hline h^0: & y_1 = p_0 & p_1 y_0 = -x_0 p_0 \\ h^1: & 2y_2 = p_1 & 2p_2 y_0 + p_1 y_1 = -x_0 p_1 - p_0 \\ h^2: & 3y_3 = p_2 & 3p_3 y_0 + 2p_2 y_1 + p_1 y_2 = -x_0 p_2 - p_1 \\ h^3: & 4y_4 = p_3 & 4p_4 y_0 + 3p_3 y_1 + 2p_2 y_2 + p_1 y_3 = -x_0 p_3 - p_2 \end{array} \tag{38}$$

This, given x_0, y_0, p_0, allows the computation of, in this order, $y_1, p_1, y_2, p_2, y_3, p_3$, ... etc. We present in Figure 11 a Fortran code[7] to compute from x_0, y_0, p_0 one step of size h to y_1, p_1 with estimated error ERR. In line 16 of this code is

[7] A Fortran code in a today's mathematical paper is, may be, *per se* a historical document; it is mainly here to show its **simplicity**, which makes it easily adaptable to other languages as Maple. One "trick" is worth mentioning: in order to reduce the extremely high values of the higher derivatives, we store in memories *y(k)* ,*p(k)* the products $h^k y_k$, $h^k p_k$.

performed the computation of p_{k+1} by division through y_0, which thus must be $\neq 0$ and, when becoming small, causes numerical difficulties.

This we embed in a standard step size control (e.g., [17, p,167]) to keep the local error $\leq 10^{-15}$, we choose $\gamma = 10$ and order $k_{max} = 20$ by stopping the calculation once $h \leq 10^{-15}$. This happens after 158 steps, plotted in Figure 11 to the right, with the results

$$x_1 = 0.1005094588171402$$
$$y_1 = 2.769495112905185 \cdot 10^{-14}, \quad p_1 = -6.963628623327027\,. \tag{39}$$

Second: the stiff part. It makes no sense to continue these calculations with the value of x always at the same place, like in Michael Jackson's Moonwalk. The idea is to continue from here with Euler's *"variabilis x ipsa in ea desit"* using equation (14) with x taken as the constant $a = x_1$ and starting from the initial values y_1, p_1. Then, equation (29) becomes, with (14), (8), and (6)

$$y \cdot \frac{dp}{dx} = -a \cdot p \quad \Rightarrow \quad y \cdot \frac{p\,dp}{dy} = -a \cdot p \quad \Rightarrow \quad dp = -a\,\frac{dy}{y} \quad \Rightarrow \quad p = -a \log y + C \tag{40}$$

```
Y(0)=Y0
P(0)=P0
Y1=Y0
P1=P0
DO K=0,KMAX-1
 AKP1=K+1
 Y(K+1)=H*P(K)/AKP1
 Y1=Y1+Y(K+1)
 SUM=H*X0*P(K)
 IF(K.GE.1)THEN
  SUM=SUM+H*H*P(K-1)
  DO J=1,K
   SUM=SUM+J*P(J)*Y(K+1-J)
  END DO
 END IF
 P(K+1)=-SUM/(AKP1*Y(0))
 P1=P1+P(K+1)
END DO
ERR=MAX(ABS(Y(KMAX)),ABS(P(KMAX)))
```

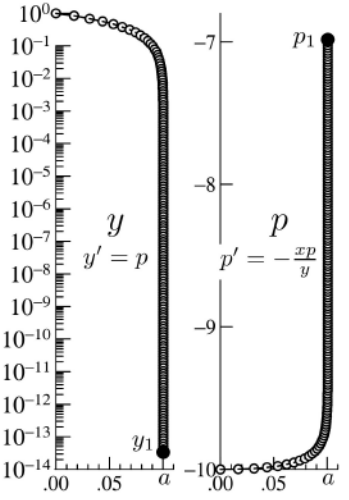


Figure 11: Code and results for the first part of the calculation ($\gamma = 10$)

Inserting the initial values from (39) gives $C = p_1 + a \log y_1$ and we obtain

$$y = y_1 \cdot \exp\left(\frac{p_1 - p}{a}\right) \quad \Rightarrow \quad y_\infty = y_1 \cdot \exp\left(\frac{p_1}{a}\right), \tag{41}$$

because y approaches y_∞ when p approaches 0. We see that y_∞ is obtained from y_1 by multiplication with $e^{p_1/a} = e^{-69.2833\ldots} = 0.81403\ldots\ 10^{-30}$ which brings y_1 down by another 30 powers of 10 to the value, together with β from (34),[8]

[8] The ⌋ indicates the position of the last correct digit, checked by still higher accuracy

$$y_\infty = 2.2544398847\rfloor 66694 \cdot 10^{-44} \;\Rightarrow\; \beta = -\log y_\infty = 100.50084253776\rfloor 69\,. \quad (42)$$

Position of the wetting front. As in (17), for finding the value of x^*, we have to integrate a second equation. From (35), x^* is characterised by $-y+x^2+xp = 0$. We neglect y (of the order of magnitude 10^{-44}) to obtain $x+p = 0$ or $p = -x = -a$. So we use $y \cdot \frac{dp}{dx} = -a \cdot p$ (the first equation of (40)), insert y from (41), separate the variables p and x and integrate for p from p_1 to $-a$ and for x from a to x^*.

This leads to

$$x^* - a = -\frac{y_1}{a}\int_{p_1}^{-a} \frac{\exp(\frac{p_1-p}{a})}{p}\,dp = y_1 \cdot \Big[\exp(\frac{p_1-p}{a})\Big(\frac{1}{p} - \frac{a}{p^2} + \frac{2a^2}{p^3} \mp \dots\Big)\Big]\Big|_{p_1}^{-a}\,.$$

As in expansion (7), the expansion to the right was obtained by repeated partial integration $\int u'v = uv - \int uv'$ with $u' = -\frac{1}{a}\exp(\frac{p_1-p}{a})$ and $u = \exp(\frac{p_1-p}{a})$. We have then to insert the boundaries $-a$ and p_1. For $p = p_1$ the exp function is 1, for $p = -a$, we have, as above, $\exp(\frac{p_1-a}{a}) = \exp(\frac{p_1}{a} + 1) = e^{-68.2833\dots} = 2.2128 \cdot 10^{-3}$ of size 10^{-3}. We thus set, with two more correct digits,

$$x^* = a + y_1\Big(\frac{1}{-p_1} + \frac{a}{(-p_1)^2} + \frac{2a^2}{(-p_1)^3}\dots\Big) \quad\Rightarrow\quad x^* = 0.100509458817144\rfloor 2\,. \quad (43)$$

Last improvement. Having now a better value for x, we can still improve our values for y_∞ and β replacing a in (41) by x^*. This gives, with two additional correct digits,

$$y_\infty = y_1\exp(\frac{p_1}{x^*}) = 2.254439884772\rfloor 974 \cdot 10^{-44}\,, \quad \beta = 100.5008425377641\rfloor\,. \quad (44)$$

Higher precision. We now write the same code in Maple[9] , which allows arbitrary precision and run the problem with $\gamma = 10^3, 10^4, 10^5, 10^6$ using equations (43) and (44) with a precision of 180 digits and an error tolerance of 10^{-160}. The first digits of the results for β are displayed in table (45):

γ	β
10^3	1000000.50000008333342361128310230279082203679102735271
10^4	100000000.50000000083333334236111128310185636122699886979
10^5	10000000000.50000000000833333333423611111128310185189694560
10^6	1000000000000.50000000000008333333333342361111111128310185185

(45)

We observe clearly the digit 1 moving left for γ^2 , the digit $.5 = \frac{1}{2}$ at the position γ^0 and the digits $0.083333333.. = \frac{1}{12}$ moving right with γ^{-2}. These are the first three terms in expansion (5). We then discover a group of digits 0.4236111111.. moving right with γ^{-4}. If we subtract from these the

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9 With the very much appreciated help of Martin Gander

previous terms 0.333333333.. , we obtain 0.0902777777777... which is again a rational coefficient. We find its fraction elegantly by a 23 centuries old idea (Eucl. VII.2): We subtract the integer part (the first is 0), invert, subtract the integer part, invert etc.:

$$0.090277777777.. = \frac{1}{11.076923..} = \frac{1}{11+0.076923} = \frac{1}{11+\frac{1}{13}} = \frac{13}{144}. \qquad (46)$$

The next following group of travellers for γ^{-6} is 0.28310185185185..., which, after subtraction of 0.11111111111.. becomes 0.17199074074074.... Here, Euclid's algorithm becomes a bit more complicated

$$0.17199074074074.. = \cfrac{1}{5+\cfrac{1}{1+\cfrac{1}{4+\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\frac{1}{10}}}}}}}}}} = \frac{743}{4320}. \qquad (47)$$

From here on we start to appreciate the continued fraction software in Maple for computing these fractions as well as the sequence of "convergents".

The first six terms. We now present in Figure 12 the results for x^* and β for $\gamma = 10^9$ (one billion), using a precision of 180 digits and an error tolerance of 10^{-160} with $k_{max} = 70$ Taylor terms for each of the 65000 steps, CPU=35.3 min. The structure of periodic digits allows us to distinguish clearly the first six terms of the expansions (4) and (5) computed in the above manner.

$$\boxed{x^* =}$$

$$1.000000000000000000500000000000000000916666666666666669465277777777$$

$$\gamma^{-1} \qquad \tfrac{1}{2}\gamma^{-3} \qquad \tfrac{11}{12}\gamma^{-5} \qquad \tfrac{403}{144}\gamma^{-7}$$

$$77778942118055555555561610204861111111148667491870590829194$$

$$\tfrac{33533}{2880}\gamma^{-9} \qquad \tfrac{1743739}{28800}\gamma^{-11}$$

$$11021610085585380422740798923238040730999434547043054 9\cdot 10^{-9}$$

$$\boxed{\beta =}$$

$$1.000000000000000000500000000000000000083333333333333333423611111111$$

$$\gamma^{2} \qquad \tfrac{1}{2} \qquad \tfrac{1}{12}\gamma^{-2} \qquad \tfrac{13}{144}\gamma^{-4}$$

$$11111128310185185185185230278935185185185332203113977072310$$

$$\tfrac{743}{4320}\gamma^{-6} \qquad \tfrac{1443}{3200}\gamma^{-8}$$

$$97076692127661249933124093806981476200459 0363917482669\cdot 10^{18}$$

Figure 12: Results for x^* and β for $\gamma = 10^9$ with 180 digits

The last three terms. For finding the last terms in each of the equations (4) and (5), we ran the computer during a week-end with 240 digits, tolerance

10^{-210} for , = 10^{-3}, 10^{-4}, ..., 10^{-15} with $k_{max} = 90$ Taylor terms and extracted these terms again by Euclid's algorithm. The digits filled the three last slides of the presentation in Gent and the people in the audience still know all of them.

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