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Science and Technology (Belgium)

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The invasion and subsequent occupation of most of Belgian territory paralyzed the scientific and technological capacities of the country during the war and its aftermath. At the same time, the conflict gave way to a profound reshaping of the cultural and political structures of Belgium's scientific and technological system. While it is difficult to overlook the extensive immediate impact of World War I on this small industrialized country, it also spurred countless initiatives that would become instrumental for the development of science and technology in the long run.

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Introduction

Assessment of the impact that World War I had on science and technology in Belgium might initially lead to the assumption that Belgium differs quite drastically from the more common historiographical overview generally proposed for countries affected by the war. Considering the elements of scientific knowledge – broadly conceived – required in the various forms of warfare, historians of science are eager to depict the conflict as the “chemists’ war”, the “physicists’ war”, or even the “engineers’ war”. On the other hand, many historians have recently offered a more nuanced approach to the issue by stressing the change in degree and scope rather than nature thus implying the mobilization of science in warfare during these four years in comparison with previous wars.[1] Whatever the scope and extent of the military-driven scientific activities, however, such views do not apply to the situation in Belgium. The country encountered an imposing, if partial, eclipse of war-related technological activities. Yet, Belgium was of course not immune to the practical outcomes of science and technology-based warfare. While an important part of these actions took place on Belgian territory, they occurred without the contribution of Belgian scientists and engineers.

However, it would be reductive to conclude that the war was merely a backdrop to the Belgian scientific and technological environment. As the reality of occupation took a hold of Belgium as a whole, it also transformed the technical-scientific landscape and more precisely the community of Belgian scientists, industrialists, and engineers and their respective worldview. Hence, the focus of this argument will be on three major shifts: the institutional setting of science in Belgium, the attitude of scientists during the course of the conflict, and the changing patterns of postwar scientific and technological organization, as well as a brief exploration of the development of medicine on the frontline and in the culture of technological innovation.

The German Model and the Quest for Scientific “Deprovincialization”

A Brief Organizational Overview

At the beginning of the 20th century, scientific research in Belgium was conducted in three different institutional settings: at universities, at the Royal Academy of Science and at state-funded independent research institutes. Only four universities comprised the full range of scientific disciplines: the University of Ghent, the University of Liège, the University of Louvain (UCL) and the University of Brussels (ULB).[2] For a long time, their role in the advancement of science was quite minor. Innovative scientific research and work was conducted elsewhere, mostly at the Royal Academy of Science. Established in 1772, it was responsible for the beginnings of “deprovincialization” among the Belgian scientific community. Prominent members of the Academy were able to inspire the creation of research institutes funded by the state. They insisted that these institutions ought to be built outside the academic environment, which was perceived as lacking the necessary drive for scientific innovation. Research institutes included the Observatory (1826), the

Museum of Natural History (1846), the Botanical Garden (1870), the Agricultural Experimental Station (1881), the Museum of the Belgian Congo (1910) and the Meteorological Institute (1913). From the late 1870s onwards, two young academics, Paul Héger (1846-1925) and Walthère Spring (1849-1911), advocated to implement the principles of a research-based, Humboldtian-type university. Trained in the medical sciences at ULB, Héger eventually switched to physiology, specializing in the field at Leipzig University. Spring, on the other hand, was trained as a chemist under the guidance of August Kekulé (1829-1896), who had taught at Ghent for several years before being recruited for Bonn University. Being the doctoral supervisor of several Belgian professors of chemistry – Théodore Swarts (1839-1911), Lucien-Louis De Koninck (1844-1921), and Albert Reychler (1854-1938) to name but a few – Kekulé's legacy in the development of academic chemistry in Belgium is huge.[3] It also became more noticeable that a strong German imprint ran across the cultural mindset of this third generation of Belgian academics, especially among natural scientists.

The Héger-Solvay Connection

Paul Héger is another case in point. His personal connection with the Belgian industrial magnate and philanthropist Ernest Solvay (1838-1922) led to one of the most accomplished examples of constructing a site for the sciences ever undertaken in Belgium: the so-called "*Cité Scientifique*", composed of seven scientific institutes, built between 1892 and 1913. The first building erected, "*Héger oblige*", was devoted to physiology. As the project grew, so did the list of generous patrons: Solvay was far from being the only backer of the "*Cité Scientifique*"[4] but he was internationally recognized as a generous patron for science. This may have prompted the German physicist Walther Nernst (1864-1941) to approach him through one of his students at the University of Berlin, the Belgian Robert Goldschmidt (1877-1935). Together with his colleague Max Planck (1858-1947), Nernst thus managed to convince Solvay to organize a conference dedicated to the progress of "modern physics", taking the first steps in the direction of quantum theory physics. The first Solvay Conference on Physics took place in Brussels between 30 October and 3 November 1911. Though it is obviously a montage, the group photograph of the participants to the first Solvay Conference on Physics remains an iconic picture today.[5]

Stimulated by the positive outcomes of the meeting, some physicists urged to organize conferences like this on a regular basis. The Dutch physicist Hendrik Lorentz (1853-1928), who had chaired the first conference, played a key role in this undertaking. Together with Paul Héger, he persuaded Solvay to set up an International Institute for Physics. The project came to fruition in 1912 and eventually branched out into chemistry after the war.[6] Although the outbreak of the war initially put the idea on hold, what was crucial was the fact that the international network of scientists built from and around the Solvay Conferences decisively contributed to put Belgium on the international map of science. In spite of the internationalist rhetoric – and Solvay's genuine commitment to internationalist values –, this "patriotic" aim had always ranked high in Solvay's mind well before the war broke out.

Into the War

Neutrality Lost

The sudden invasion of neutral Belgium by the German troops on 2 August 1914 and, most of all, the subsequent occupation of the bulk of the Belgian territory – 2,598 out of a grand total of 2,636 municipal districts fell under German control[7] – resulted in a complete disconnect of the members of the Belgian scientific community from their international counterparts. Belgian scientists were not only sucked in the antagonistic vortex of two "hostile camps", but also became witnesses of their country's (and their own, in turn) weakness. The reality of living under occupation, as well as to the bulk of the Belgian population, created an original and brutal experience of socialization (*Vergesellschaftlichung*) characterized by deprivation, exile and protests. Therefore, any account of scientific and technological development in wartime Belgium should be converted into a social history of science, highlighting the role and attitude of scientists during the war. In her pioneering work on the subject, Brigitte Schröder-Gudehus has singled out the importance of the *Aufruf an die Kulturwelt* (hereinafter referred to as the "Manifesto") signed by ninety-three German scholars and artists on 4 October 1914, igniting the mobilization of the international scientific community.[8] More recently, historians have nuanced the shift by underlining the continuity of military-driven scientific research before and after World War I.[9] Whichever position one takes, there is no doubt that the destruction of the library at the University of Louvain on 25 August 1914 was a watershed moment in the development of collective mobilization of scientists. Next to other war atrocities perpetrated by German troops in Belgium, this infamous episode was specifically exploited by Allied forces as a propaganda tool designed to manipulate pacifist and neutral commitments among intellectual milieus.

In Belgium, however, the burning of the Louvain library had more than merely symbolic consequences. It coincided with the slow but ineluctable dispersion of the academic community after university leaders had confirmed the impossibility of resuming activities. Contrary to a myth forged after the war, the decision to close universities had not been the result of a patriotic attitude adopted unanimously in solidarity with students that had been sent to the frontline. Rather, the interruption of 1914 was dictated by the imminence of important practical constraints. On the other hand, the decision to keep universities closed through 1915 and after can be seen as an act of political disobedience in opposition to the occupying authorities who had urged university leaders to open their establishments. Political tensions grew even stronger after governor-general Moritz von Bissing (1844-1917) ordered the establishing of the "*Vlaamsche Hogeschool*" (Flemish Superior School) in October 1916, in accordance with the politics of netherlandization ("vernederlandsing" in Dutch; "flamandisation" in French) of the University of Ghent, which was itself a mere execution of the wider program of *Flamenpolitik* planned by the German high-commander.[10] For most Belgian scholars, the creation of the so-called "von Bissing University" was an explicit sign of exerting control over academic affairs. The refusal of historians Henri Pirenne (1862-1935) and Paul Fredericq (1850-1920), both professors at the University of Ghent, to yield to German pressure eventually resulted in their deportation and imprisonment in Germany – a situation that caused much protest.[11]

Academics in Exile

Meanwhile, many scientists had gone or been forced into exile. As early as September 1914, measures had been taken to avoid that academics remained idle. Paulin Ladeuze (1870-1940), rector of the University of Louvain, told the faculty that “professors could reply individually to the generous invitations they were offered” by foreign universities while the war was going on.[12] Academics in exile were thus working at Oxford and Cambridge universities, but also at academic institutions in France and the Netherlands. An important group of professors settled in the refugee camp at Amersfoort near Utrecht, where they started to offer spontaneous classes to their fellow compatriots. While Ladeuze stayed in Louvain during the conflict, Paul Héger, who had become president of the ULB, left Brussels in May 1915 to attend his niece Marie Depage's (1872-1915) funeral, who had been one of the victims of the sinking of the ocean liner Lusitania, which was torpedoed by a German submarine on 7 May 1915. She was on her way to the United States with the intention of raising funds for the military station hospital – the *Ambulance de l’Océan* – which had been established near De Panne on the Belgian coast. The Ambulance was built and organized by her husband, the surgeon Antoine Depage (1862-1925). A professor of medicine at the ULB and founder of a private surgical hospital in Brussels that employed Edith Cavell (1865-1915) as head nurse, Depage had taken advantage of his privileged relations with Albert I, King of the Belgians (1875-1934) and Elisabeth of Bavaria, Queen of the Belgians (1876-1965) to team up with the Red Cross and turn a former hotel into a state-of-the-art emergency hospital. The Ambulance was equipped for 200 patients at the beginning of the war; the number had risen to 900 by 1916 and was at 2000 by the time the war drew to a close. Depage had gained some notoriety with a surgical technique called “debridement”, which was the removal of potentially infected tissues so as to avoid further contamination. In Depage's own words: “The wide debridement of the wound, with resection of contused tissue and removal of particles of clothing and other foreign bodies, must be considered a strict rule.”[13] Alexander Fleming (1881-1955) and Marie Curie (1867-1934) had visited the hospital during the conflict; the former to undertake some bacteriological studies, the latter to supply it with radiological equipment. After the war, Depage’s fame was such that it prompted an important endowment from the Rockefeller Foundation for the construction of a new institute for the training of nurses. Conflicting views among Depage, the administrators of the Foundation and the ULB (including Paul Héger) prevented the project from being realized. Alternatively, the Rockefeller Foundation funded the new School of Medicine of the ULB.

The experience of wartime exile affected an important group of scholars and contributed to their socialization. While a minority left the country at their own risk, most of them relied on outside help in order to obtain the necessary papers. In this respect, one should stress the involvement of Hendrik Lorentz, whose role in enabling the mobility of Belgian scientists outside Belgium was instrumental. A mediator par excellence, Lorentz employed his international reputation to mobilize an extended network of scientists for humanitarian purposes throughout the war. Beneficiaries who were of assistance to him in obtaining travel documents included the ULB physicist and member of Solvay’s International Institute for Physics’ administrative committee Jules Verschaffelt (1870-1955), who

went on to teach at the University of Utrecht, the UCL mathematician Charles-Jean de La Vallée-Poussin (1866-1962), as well as Ernest Solvay himself as he wished to spend the summer of 1918 in Switzerland. Obviously, prewar international networks of scientists and wartime political bindings overlapped. To a large extent, the life of historian Henri Pirenne is emblematic of the changes and re-evaluations which, too, were happening among Belgian scientists and scholars during the war. With a reputation and scholarly activities that had made him well-established within German academic circles before the war, Pirenne's experience as an inmate at camps in Krefeld and Holzminden was instrumental in reconfiguring his understanding and his writing of the history of Germany, Belgium and Europe in general.[14]

Pamphlets and Protests

Public condemnation of the "atrocities" perpetrated by the German forces were another aspect of the unexpected wartime socialization. The ULB biologist Jean Massart (1865-1925) was at the forefront of the group of opponents.[15] The outbreak of the war transformed this discreet professor of botany and former curator of the State Botanical Garden into a staunch political activist. With the same meticulousness with which he used to collect plant species, he started to gather documentation concerning various aspects of the occupation. Further, his professional obsession with scientific photography made him an astute photographer in the fields of everyday administration and propaganda posters. After he had contributed to the clandestine press, the threat of imprisonment forced him and his family to cross the Dutch border in August 1915. After a long journey via England, the family eventually settled in the south of France, where they remained until the end of the war. Massart published several anonymous pamphlets aimed at denouncing the conditions of the occupation in Belgium. Two of them were even translated into English.[16]

The German Manifesto caused a bigger tidal wave of protests from scientists in Belgium than anywhere else in the Allies' camp. Héger did not wait long to express his "formal" disapproval. On 2 November 1914, he wrote the following to Hendrik Lorentz:

> When time will come for reality to be known, when facts will appear under their true light, the statements [made in the Manifesto] will be seen as outrageous despite the fact they were ratified by prominent men; what I have seen and what I know allow me to make you that formal declaration.[17]

He would go on to refer to the "crime of the Lusitania" as an example of the "methodological cruelty" of the German army. "Will there still be neutrals after this humanity?", he aggressively questioned his Dutch correspondent. In fact, the neutral Lorentz was overwhelmed with letters filled with anger and complaints from his French and Belgian colleagues. As early as 12 September 1914, the French physicist (and participant to the first Solvay Conference on physics in 1911) Marcel Brillouin (1854-1948) asked Lorentz if he was aware of any disapprobation among their German colleagues about the invasion of neutral Belgium and what he called the "sack of Louvain". The Manifesto offered only a "sad reply", he related to Lorentz in his next letter, though he made it clear that he had "never really

hoped for a protest, except perhaps from Einstein."[18]

Caught between the two camps, Lorentz managed to exert some influence on his German colleagues and friends Max Planck and Emil Warburg (1846-1931) by sending them booklets published by the Allies about German soldiers' misconduct (like Joseph Bédier's *Les Crimes Allemands*). Conversely, Lorentz also ensured the diffusion among Allied scientists by way of Planck's repudiation letter from March 1916, an act with which he greatly distanced himself from the Manifesto which he and others – including Walther Nernst and Adolf von Harnack (1851-1930) – had signed too hastily.[19] His purely intermediary attitude put Lorentz into a position of special agency, dedicated to wartime pamphlets and mutual protests. For instance, Massart sent him his own reply to Planck's repudiation letter under the following title "How German intellectuals step back in the search for truth" (April 1916). Through the channel of another neutral go-between, the Swiss botanist Robert Chodat (1865-1934), Massart had campaigned to launch a non-partisan committee to investigate on the responsibilities of the crimes committed in Belgium for months. His efforts proved fruitless.

After the war, Lorentz called upon Ernest Solvay to reintegrate German scientists in the Conferences on Physics. In a letter from 9 January 1919, he requested "not to exclude them forever", pointing to the outstanding roles and contributions of some individuals who, like Einstein, "were not 'Germans' in the sense that we frequently give to this word now".[20] These efforts, too, did not lead anywhere. Like most of the international scientific relations after 1918,[21] the Solvay Conferences committed to the politics of boycotting rather dogmatically. A return to normalcy was only possible with a meeting in October 1927, – perhaps the most famous and interesting sessions in the history of the Solvay Conferences – after Lorentz had made sure he had secured King Albert's blessing. "Considering all the things Germans have done in physics, it [is] very difficult to move on without them", Albert had supposedly said to Lorentz.[22] Thus, anti-German hostility was not given a lot of space at Solvay International Institutes for Physics and Chemistry, where the noticeable absence of German scientists was undermining the scientific prestige of the conferences. The pressure to exclude had been lobbied first and foremost by national academies. Together with their French colleagues, Belgian scientists were leading in the pursuit of mobilization.[23] The Belgian astrophysicist George Lecointe (1869-1929), who had spent the war in exile in the Netherlands and France, took an active part in the preliminary conferences of the Inter-Allied Academies of Science which eventually gave way to the establishing of the International Research Council in Brussels in July 1919. With the French mathematician Emile Picard (1856-1941), Lecointe was at the head of the hardliners, advocating the unconditional exclusion of scientists from the former Central Powers, even when the politics of boycott started to wane after 1925.[24] This attitude put him in sharp contrast with the Belgian scientists involved in the Solvay conferences.

Bridging the Technological Gap

The Organizational Impulse

While Belgian intellectuals and scholars remained eager to pursue their work, even under difficult circumstances, several industrialists and engineers were utilizing the occasion of the occupation to set the stage for a thorough reform of the country's technological system. Initiatives sprung up in various fields and contexts, including branch management organizations, associations of engineers and networks of alumni. But the underlying rationale of these projects was a common one, namely to prevent the Belgian industry from lagging behind other industrial nations after the war and to foster a new industrial spirit. The secret meetings of these semi-formal committees dealt with the promotion of in-house industrial research, the transformation of labor organization, the diffusion of American-type scientific management, and the adjustment of technical higher education to the needs of industry. Some of these private initiatives were taken over by the public sector. Impressed by the British and French wartime achievements in terms of industrial efficiency, the Belgian government (in exile in Sainte-Adresse) set up the Mission in the United States on Industrial Management shortly after the war. The mission, composed of industrialists and labor leaders, toured several plants in the United States in early-1919 "in order to study the movement better known under the name "Taylorism" in Europe and "scientific management" in the United States".[25] With the notable exception of its thick two-volume report, the mission's tangible results and influence proved rather limited on the whole.[26] The very conservative Industrial Central Committee, Belgium's inter-branch federation of industrialists, also paid close attention to the problem. Modeled on the US Bureau of Labor Standards and the German *Physikalisch-Technische Reichsanstalt*, it initiated the founding of the Belgian Association of Standardization in 1919. But the scope of this new technical grouping was soon disputed by rival committees. Therefore, it is no wonder that the International Labor Organization had to cope with the mushrooming of an array of national committees dealing with scientific management in Europe.[27]

Adjusting Science to Industry

The transformation of teaching programs in engineering schools, which function as part of the university-system in Belgium, was by far the most successful reform project undertaken by private wartime committees. For once, the discussion between industry and university was comparable to an actual dialogue.[28] On the one hand, industrialists who were used to complaining about the lack of "adaptability" of technical higher education were urging universities to "give satisfaction to the industry considered as a whole", as a delegate of Liege's *École des Mines* put it rather drastically.[29] University leaders, on the other hand, were well aware of the challenges they would encounter in the scope of the "industrialization of science",[30] to quote rector Paulin Ladeuze and most of them considered this renewed interest a window of opportunity for the evolution of the university-system. But striving for an extension of industry-oriented research facilities also concerned natural sciences. Departments of chemistry turned out to be hot spots for reform attempts. With the institutional model derived from the *Kaiser-Wilhelm-Gesellschaft* created in 1911, several initiatives focused on the

expansion of chemical research adapted to the development of industry. Here again, rector Ladeuze encouraged the alliance with private firms and relied on the enthusiasm of the young professor of organic chemistry Pierre Bruylants (1885-1950) to resolve certain practical matters. Bruylants had received a special training in electrochemistry at Aachen's *Technische Hochschule*. During the war, he became a consultant for a firm that specialized in the coal-tar dyes industry, while his father rekindled his connections with chemical firms based in the Antwerp region (Wilsele and Gevaert). When he reached out to Pierre Bruylants regarding the foundation of the Institute for Industrial Chemical Research as he envisioned it, rector Ladeuze alluded to the growing opportunities of university-based industrial research but the project stalled for a while. After the war, it was instrumental in setting up an Institute for Chemistry, whose contribution to the national chemical industry was less ambitious than first planned.

Conclusion: Between Standstill and Postwar Miracle

After enduring years of wartime occupation, the prospects for science and technology were bleak. More and more universities had been shut down throughout the conflict. Industrial firms, whose commitment to research-and-development was quite modest in comparison with surrounding industrial countries, were slow to recover. Last but not least, scientific research did not rank among the government's priorities. Impressed by foreign precedents, Georges Lecointe appealed to the creation of a National Council for Research. He stated that "the country would commit another mistake if it were to use its current budget deficiencies as an excuse to avoid coming into its industrial future".[31] But his call was received with complete indifference or even disdain by public authorities on their return from exile. Results came from the backdoor of relief initiatives, namely through the liquidation of the (Belgian) National Committee for Food and Relief, headed by the financier Emile Francqui (1863-1935) and the (American) Commission for Relief in Belgium (CRB), led by Herbert Hoover (1874-1964). The wartime story of this epic tandem is a tale told often as it saved millions of lives from starvation.[32] But Francqui and Hoover's cooperation continued to be helpful even after the war was over. Thanks to subtle and creative accounting techniques, they were able to transfer the remaining capital of Belgian relief organizations to Belgian universities, initiating the creation of so-called "scientific foundations". This endowment paved the way to an array of private donations, all of which permitted the expansion of Belgian universities and higher education. Considering the magnitude of the postwar drive, the efforts of this Belgian-American network gave the scientific and technical environment in Belgium a fresh impulse in the 1920s – and a decisive entry into the 20th century.[33]

The side-effect of this revival was the sudden displacement of the center of gravity in terms of science-making. Whereas the Belgian pre-war scientific elite had been embedded in the intellectual dynamics of Bonn or Heidelberg, the coming postwar academic generation was swearing only by the research facilities supplied by Harvard or Stanford. The First World War undeniably facilitated this shift. Some might even argue that Belgium's scientific and technological "deprovincialization" was

completed by making Belgium a satellite of the United States.

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