Mathematics and Mathematicians in Nancy during World War I

Laurent Rollet, Philippe Nabonnand

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I. Introduction

In 1870, Nancy had 43.000 inhabitants. Forty years later, in 1914, it had 120.000 inhabitants. Between 1870 and 1914, Nancy was one of the few French cities to undergoa strong demographic growth (140%). Two elements can explain this situation. One of the consequences of the Industrial Revolution after 1850 was the development of mining, iron and steel industries in Lorraine and the increasing needs of workforce. But this appeared to be a minor factor in the case of Nancy because of its geographic situation. The second explanation finds its source in France's defeat in the war of 1870. After the war the governments of the new Third Republic gave a strategic role to Nancy through the installation of many troops and regiments. The town quickly became a *ville-frontière* and a garrison town.[2] Moreover a large number of Alsatians and Lorrains (more than 13.000 in 1877) refused German nationality and decided to settle in proximity to their homeland.

This demographic shift had an intellectual and a scientific impact. The loss of the University of Strasbourg largely benefited Nancy: a great number of professors left Strasbourg to reinforce Nancy's intellectual institutions.[3] Furthermore, the University of Nancy had to deal with a large number of students coming from Alsace and Moselle.[4] The benefit for the University of Nancy was evident, especially in the scientific disciplines. For instance, the *École pratique de médecine* was transformed into a Faculty of Medicine and this had important intellectual and cultural repercussions outside the university. Paradoxically, the defeat of 1870 led to the emergence of an intellectual and artistic golden age symbolized by the *avant-garde École de Nancy*.

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[1] Laboratoire de Philosophie et d'Histoire des Sciences – Archives Henri Poincaré, UMR 7117 du CNRS et de Nancy-Université. The authors wish to tank Prosper Doh for his careful rereading and Jean-René Cussenot for his very helpful historical database devoted to the professors of the Faculty of Science of Nancy: http://www.atela.uhp-nancy.fr/cussenot2/index.php.

[2] In 1913, the military population represented almost 9% of the whole population. In 1866, this proportion was far less important (around 1,2 %)

[3] Concerning the history of the University of Strasbourg cf. [Crawford & Olff-Nathan 2005].

[4] The mathematician Paul Appell was Alsatian and began his studies in the *classe de mathématiques spéciales* of the imperial college of Nancy. He met there Henri Poincaré who became one of his closest friends. [Appell, Adam, & al. 1913], [Appell 1925].

The First World War put an end to this brilliant period. In 1918, Nancy returned to its status of one among other ordinary provincial towns with its university losing some of its specific characteristics acquired in the aftermath of the 1870 war.

The purpose of this article is not so much to present a broad picture of the history of the University of Nancy between 1870 and 1918 but to analyse the situation of mathematics and the role played by mathematicians in Nancy during World War I. Despite the restricted scope, this history will cover various topics: the increasing pre-war importance of applied research and engineer training in Nancy, the tight collaborations between mathematicians and physicists to create an aerodynamic institute, the relationships between the Faculty of Science and the army, the involvement of mathematicians in the life of the City, etc. The study of these issues boils down to analysing the workings of a very small community (in 1914 there were only 4 chairs in mathematics in Nancy) and the capacity of its actors to elaborate ambitious projects and obtain massive support from the University, government ministries and the general public.

The first part will be devoted to a survey of the 'golden age' of the Faculty of Science of Nancy before World War I, especially the pioneering development of technical institutes and the role played by mathematicians in this process. The second part will deal more precisely with the involvement of the mathematical community in the war, both on the military and the home fronts, and the damaging consequences of the war. The third part will finally examine a peculiar consequence of the conflict, i.e. the demise of the aeronautics curriculum in Nancy and the leadership role of Gaston Floquet in its pre-World I development.

II. The Faculty of Science before World War I

At the turn of the nineteenth century the evolution of the University of Nancy was characterized by a scientific project centred on the development of applied sciences in a patriotic perspective. The historian Edgar Quinet, in 1873, gave the following vivid description of this patriotic agenda:

> Faites de Nancy un autre Metz, un autre Strasbourg au point de vue moral et intellectuel. Vous le pouvez en attirant les générations nouvelles d'Alsace dans un grand centre d'enseignement scientifique que nous fonderons sur notre nouvelle frontière.

Convinced that the loss of the war was partly due to lack of research in the applied sciences and to the incapacity of science to help industrial development, many universities decided to create technical institutes devoted to the training of technicians and engineers for the local industries. The creation of these institutes was financed by the Ministry of Public Instruction, by local political institutions (*conseil général*, municipal council of Nancy, etc.) and by industrial firms. The University of Nancy was part of this movement towards engineer education; the period from 1887 and 1914 saw the founding of the *institut chimique* (1887), a school of brewery (1893), the *institut électrotechnique* (1900), the *institut botanique agricole et colonial* and the very ephemeral *institut d'aérodynamique*.[5] The most influential actors of

[5] [Grelon & Birck 1998], [Birck & Grelon 2006], [Rollet & Choffel-Mailfert 2007].

this history were the Alsatian chemist Albin Haller (1849-1925), who was the first director of the school of chemistry, and the physicist Ernest Bichat (1845-1905). As president of the *conseil général de Meurthe-et-Moselle*, Bichat had political and economical networks in Lorraine; he was moreover a strong promoter of close relationships between science and industry and his action led to the creation of the *institut chimique* and the *institut électrotechnique*. From 1888 until his death he was both the dean of the Faculty of Science and member of the *conseil supérieur de l'instruction publique*. His successor to the deanship, the mathematician Gaston Floquet (1847-1920), continued his work by promoting the development of aeronautics and meteorology. The Belgian manufacturer Ernest Solvay (1838-1922) also played a leading role in this process by giving generous subsidies to the technical institutes between 1890 and 1914.

As an auxiliary discipline, mathematics was a decisive component of the *curricula* in the technical institutes. This situation raised the problem of mathematical training in engineer studies, a central pedagogical concern within the mathematical community was to find the correct balance between pure and applied mathematics in engineer education knowing that engineering students did not necessarily have a good initial mathematical training.[6] One of the consequences of the 1896 university reforms (which gave official status to the University of Nancy) was the creation of the *certificats de licence*. Thanks to new subsidies from the municipal council and the *conseil général*, the Faculty of Science was able to develop new courses in applied physics and applied mechanics. This contributed to the strengthening of relationship with local industries. Industrial physics courses were created in 1899 by the physicist F. Perreau, who was then *maître de conférences*, and the mathematician Henri Vogt, who was elected to the chair of applied mathematics in 1899 and was in charge of applied mechanics courses. Vogt was actively involved in pedagogical reflections on the connections between mathematics and the applied sciences.[7]

Before World War I, mathematical *curricula* were divided in two main parts. In order to obtain a *licence de mathématiques* students had to pass several certificates (differential and integral calculus, rational mechanics, higher geometry, analysis and astronomy), some of which were quite difficult to obtain. Engineering students could prepare this diploma. But the new curriculum, *certificat de mathématiques générales*, created in 1908 became the core of their mathematical training. During their studies, engineers also had to obtain certificates in other scientific disciplines (such as general and applied physics, rational mechanics, etc.).

Before 1914, universities paid special attention to adapting mathematical training to the needs of a new student population: indeed, one of the consequences of the reforms of the 1890's was the opening up of the Faculties of Science to students who did not come from *classes de*

[6] *Baccalauréat* was not compulsory to study in those technical institutes and students did not always come from the *classes préparatoires aux Grandes Ecoles.*

[7] Concerning the aims of mathematical training in engineer education, he thus declared in 1911: « Il ne s'agit donc pas d'affaiblir l'enseignement des mathématiques, mais de le diriger vers le but à atteindre ; s'il est réduit en étendue, il doit être approfondi et approprié aux applications; il doit être poussé jusqu'à la détermination des valeurs numériques et de l'approximation qu'elles peuvent comporter ». [Nabonnand 2006].

mathématiques spéciales. The University of Nancy in particular had an important foreign student population much of which could not follow the *certificat de calcul differential et integral* for lack of the prerequisite training. In many universities (be it in Paris or in province) there were debates and discussions concerning the best way to receive these students. The solution adopted was the creation of the *certificate de mathématiques générales,* a new certificate the curricula of which were analogous to those of the *classes de mathématiques spéciales*. Nevertheless, this was not enough: in Nancy, the large influx of foreign students without solid initial training in mathematics and the sciences led to the creation of new courses in 1908 organized into a one-year prerequisite preparation to the technical institutes. The academic community of the Faculty of Science was keenly aware that foreign students constituted one of the keys of the success of these institutes and accordingly devoted the time and money needed to cater for and retain this new student population.

Was the beginning of the 20th century a kind of golden age for the University of Nancy? Before 1914, the University of Nancy was one of the most active provincial universities, especially in the scientific and medical fields. Prior to the N-Rays affair, René Blondlot was enjoying international reputation for his electromagnetic experiments of the 1890's. From 1907, Edmond Rothé was closely involved in the research on wireless telegraphy (this technique allowed the *Observatoire de Paris* to communicate the exact time to the Faculty of Science in 1910). He also shared with Floquet great interest in aerodynamics and meteorology.[8] In 1912, Victor Grignard was awarded the Nobel Prize in chemistry. New buildings and new laboratories were erected: in 1897, Haller obtained a very important subsidy from the *Société industrielle de l'Est* for the creation of a laboratory devoted to electrochemistry and physical chemistry. Solvay offered 100 000 Francs for this project to be followed, three years later, by an equivalent subsidy for the creation of a laboratory devoted to electricity and electrical engineering. In 1906, following Bichat's project, the *institut de mathématiques et de physique* to be dedicated to pure science was constructed close to the technical institutes. In 1913, Solvay offered another important subsidy (500 000 Francs) which allowed the extension of the electrical engineering laboratory, the creation of a chair of electrical engineering (attributed to Alexandre Mauduit) and the transformation of the previous *maîtrise de conferences* in electrical engineering into a *maîtrise de conferences* in physics on condition that the professor also taught mathematics. This chair was held by the physicist Grumbach.[9] At the same time, Louis Maurice Roy was recruited as *chef de travaux pratiques de mathématiques avec charge de conférence*.

Consequently, the material conditions were quite good for research and educational activities. Nevertheless this situation was in a way artificial. As in other provincial faculties, the number of students was rather low: good students from *classes préparatoires* usually opted for the Parisian *grandes écoles*. As a result, the technical institutes were obliged to widen their recruitment requirements to accept best students from the *école primaire supérieure* or from

[8] As we shall see, he would be the first (and only) director of the *institut aérodynamique*, officially founded in 1913.

[9] [Birck 2006]. See also: [Choffel-Mailfert 2007].

the *école professionnelle de l'Est*. To solve this demographic and financial problem, the Faculty of Science and its institutes opened up to the admission of foreign students from 1902 following the model of the German *technische Hochschulen*. The University of Nancy was one of the first to develop an active policy to attract foreign students with the help of the *Société des amis de l'université* which was engaged in active lobbying outside France. The first consequence of this drive was the demographic weight of foreign students in Nancy. In 1914 for instance, of the 1089 students enrolled at the Faculty of Science, more than 600 were foreign students most of which were enrolled in the schools of chemistry and electricity.[10] The second consequence was the important rate of failure in the exams for the scientific certificates (see tables 1 and 2 below).

Despite these problems, official discourses before 1914 was very optimistic and its rhetoric praised the harmonious relationship between academic research, industrial development and patriotism. Nancy was thus said to be in the forefront of modernity and dynamism. In 1912, the chemist Paul Petit – he was then the assessor of the dean of the Faculty (Floquet) – expressed this satisfaction very clearly:

> L'outillage, si complet déjà, de notre Institut, s'est augmenté d'appareils pour les essais de résistance des matériaux […]. Comme on le voit, l'Institut de mécanique conserve sa réputation justifiée d'Institut modèle et en même temps il tient à rendre à l'industrie régionale tous les services de son ressort. En Allemagne, les entrepreneurs font constamment usage des essais de résistance pour les matériaux qu'ils utilisent et notre Institut sera maintenant en mesure de répondre aux demandes qui lui avaient été déjà adressées.[11]

III. Mathematicians during the war

Before World War I, there were 4 chairs of mathematics in Nancy: analysis (Floquet), applied mathematics (Vogt), rational mechanics (Husson) and differential and integral calculus (Husson).[12] In addition to the three professors, four part-time lecturers were in charge of courses, especially in the technical institutes. Bertrand was a professor at the *École professionnelle de l'Est* and had the responsibility for practicals at the institute of electrical engineering (from as early as 1906 to 1920). Chanzy, who was professor at the lycée of Nancy[13], was in charge of practicals, mathematical conferences and graphical works, from 1903 to 1908 at the *institut chimique*, and then at the *institut electrotechnique* (as late as 1920). Pol Simon, a science graduate from the Faculty of Science, carried out practical works in mathematics at the chemistry school. He continued these courses at the newly founded *institut métallurgique et minier* after the war. Finally, the engineer Louis Roy was recruited in

[10] Most of which came from Russia. See: [Birck 2006], pp. 37-41; [Gouzévitch & Gouzévitch 2006].

[11] Comptes rendus de l'université de Nancy, 1912, p. 29.

[12] Actually, Husson had been elected in 1914 on the chair of rational mechanics. Nevertheless, since he was mobilized during the war he did not hold this chair between 1914 and 1918 and kept the responsibility of the chair of integral and differential calculus. The chair of rational mechanics remained thus unoccupied during the war.

[13] Which was to become in 1913 the *Lycée Henri Poincaré.*

1913 as chief of practical works in mathematics. Roy graduated from *Supelec*, where he obtained a diploma in engineering and a doctorate in science. After the war, he specialized in rational and applied mechanics and made a brilliant career at the University of Toulouse.

The two categories of professors constituted the mathematical workforce in Nancy at the beginning of the war. Of course, some physicists, such as Grumbach, could be involved in mathematical training (see *supra*), but the seven persons mentioned above were at the centre of mathematical training at the faculty of science. Two points are worth noting. On the one hand, in the light of the historical materials at our disposal, there wasn't any *maître de conférences* in mathematics at that time. On the other, because of the military mobilization the workforce was substantially reduced during the war. Nevertheless, as we shall see in the next section, the episodes of the construction of the *institut d'aérodynamique* show quite clearly that the mathematical perimeter was much larger involving close collaborations with physicists (Camille Gutton, Edmond Rothé, Maurice Guéritot, Alexandre Mauduit, Ernest Hahn or Faillot) as well as with local military officers.

In light of the official chart of the faculty (*Comptes rendus de l'université de Nancy*) and of the administrative decrees of nominations, Bernard was no longer in the faculty after November 1914.[14] Roy probably had to leave the faculty at the end of 1915 or at the beginning of 1916. Despite his poor health, Pol Simon enlisted in the army at the beginning of the conflict as lieutenant instructor in the infantry. After the war he was mentioned in dispatches for his courage during a combat. As for Chanzy, his presence seems to be attested as late as 1916.[15]

At the beginning of the war, Edouard Husson (integral and differential calculus) was put on active service as a sergeant in the territorial regiment of the infantry in Toul near Nancy. This situation allowed him perhaps to maintain some of his activities in Nancy and it is likely that he kept a part-time activity at the university until November 1916.[16] He then became a technical *attaché* in an aviation centre and finally rejoined the school of aviation in Pau as technical instructor. As for the physicists, Alexandre Mauduit (electrical engineering) was mobilized as an engineering captain in Toul while Edmond Rothé joined the radiographic service of the military hospital in Nancy (and continued to teach at the onset of the war). Apart from military mobilization, some professors of the Faculty of Science were also involved in inventing various technical devices for the army. Camille Gutton constructed a grenade detector, Rothé built a field radiographic car and an anemometer, Guéritot, who was in charge of practicals in electricity, developed with Rothé a mechanism for the use of

[14] Were they sent to the army? This hypothesis is indeed plausible, but one could also suppose that their part-time lectures were suppressed because of the decrease of the number of students. Despite the lack of precise information concerning the two teachers it seems also reasonable to assume that they were more than 40 years old.

[15] But the official charts of the Faculty of Science contain many errors. For instance, Simon is mentioned until 1917 although he was in the army since 1914.

[16] His name is present in the organization chart of the faculty but the *Comptes rendus de l'université de Nancy* don't mention any of his courses, which seemed to be made by Floquet.

wireless telegraphy in aeroplanes. René Blondlot, who was professor emeritus, worked on periscopes.

In concrete terms, Vogt and Floquet, who were of the older generation, were in charge of all the courses during the war. In 1914-1915, Vogt gave more than 8 courses per week and Floquet was in charge of differential and integral calculus.[17] In 1915-1916, Floquet was in charge of rational mechanics and advanced analysis while Vogt taught general mathematics. During the next academic year, Floquet taught differential and integral calculus as well as astronomy and Vogt kept the charge of general mathematics. Vogt also gave courses in applied mathematics and ensured (with Chanzy?) practical works in mathematics. The first consequence of the war was a reduction in the number of professors. In 1915, the faculty of science lost 12 of its 22 professors.[18] The second consequence was a sharp drop in the number of students at the Faculty of Science. In 1913-1914, there were 1089 students with a large proportion of foreign students. A year later, there were only 114 students with not a single foreign student left (see Table 1 below).[19] And this was not without repercussions on the number of diplomas and certificates delivered (see Tables 2 and 3 below).

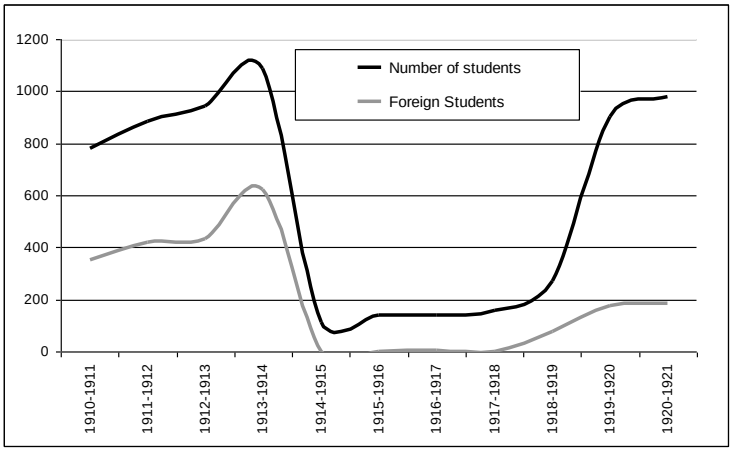

Table 1 – French and foreign students at the Faculty of Science of Nancy (1910-1921)[20]

[17] At the beginning of 1914 academic year, all the courses in which some students had been registered had been opened. For lack of students the courses of rational mechanics, astronomy, aerodynamics and brewery had been suppressed.

[18] The situation was quite comparable in the other faculties: 7 out of 17 at the Faculty of Law, 5 out 18 at the Faculty of Medicine, 7 out of 14 at the Faculty of Arts and 9 out of 10 at the *École supérieure de pharmacie*. *Comptes rendus de l'université de Nancy*, 1916.

[19] In 1914-1915, the Faculty of Law had 66 students, the Faculty of Medicine 27, the Faculty of Arts 18 and the *École supérieure de pharmacie* 25. *Comptes rendus de l'université de Nancy*, 1916.

[20] Source: Comptes rendus de l'université de Nancy.

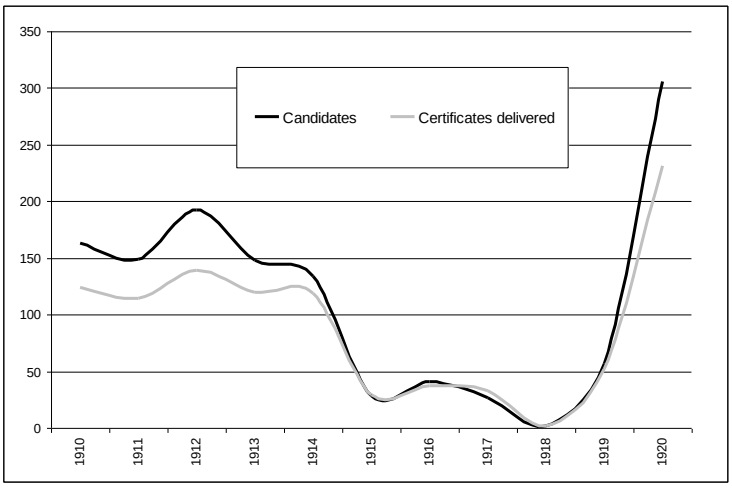

Table 2 – Evolution of the *certificates de licence de sciences* at the University of Nancy (1900-1920) for all disciplines[21]

Year	A	B	C	D	E	F	G	H	I	J
1900	3		0	0	3	4			9	10
1901	16		0	1	0	1			2	1
1902	16		2	0	1	3			8	3
1903	16		0	0	0	6			10	5
1904	22		1	2	0	4			7	11
1905	14		4	2	0	2			16	8
1906	20		0	1	3	0			9	8
1907	29		4	0	1	9			20	8
1908	0	29	4	0	0	4		6	15	14
1909	8	10	6	0	0	1		7	12	12
1910	3	18	4	0	0	0		5	11	19
1911	3	21	4	0	0	2	4	8	13	7
1912	5	22	4	0	0	5	7	7	20	10
1913	11	14	7	0	2	7	9	4	11	13
1914	4	14	5	0	3	3	9	7	11	0
1915	5	10	3	0	0	3	1	0	2	0
1916	2	7	2	0	0	0	6	2	2	1
1917	3	9	0	1	0	3	0	5	2	0
1918	1	0	0	0	0	0	0	0	1	0
1919	4	19	0	0	0	0	8	7	0	0
1920	6	96	0	0	3	0	10	19	10	6

Table 3 – Number of various certificates delivered in mathematics and physics at the Faculty of Science of Nancy (1900-1920) – A (differential and integral

[21] Source: *Comptes rendus de l'université de Nancy*. See also [Nabonnand 2006].

calculus) – B (general mathematics) – C (higher analysis) – D (higher algebra) – E (higher geometry) – F (astronomy) – G (rational mechanics) – H (applied mechanics) – I (general physics) – J (applied physics)[22]

During the war, the academic discourse praised the professors who served in the army and those who, because of their age, had to stay in Nancy, on the home front. Perhaps in order to evade ill fortune, this situation was even seen as a chance for the university as shown by this quotation of Arthur Meyer in November 1915 at the start of academic year:

> Loin de nous la pensée de nous plaindre de cette diminution momentanée : ceux qui sont partis remplissent aujourd'hui le plus noble des devoirs ; quant à ceux qui ont pu demeurer, MM. Les Doyens sont unanimes à se féliciter de leur travail et de leur assiduité. Les résultats ont été excellents. Souvent la leçon habituelle devient un entretien pour ainsi dire particulier, pour le plus grand profit de l'élève ; telle séance de travaux pratiques ressemble à l'expérimentation de recherche que le maître fait avec ses quelques assistants de laboratoire ; ailleurs, l'enseignement clinique se confond avec le travail clinique auquel se livrent, sous l'œil du chef, les élèves devenus des collaborateurs pour les soins aux blessés. Parfois, une leçon, un examen sont momentanément interrompus par le tocsin et la canonnade signalant une incursion d'avions ; l'incident passé, la séance continue ; et l'on ne saurait trop insister sur la fermeté tranquille avec laquelle nos élèves se sont adaptés aux conditions peu ordinaires de la vie universitaire à Nancy.
>
> Cette rapide esquisse de l'activité de nos collègues non mobilisés serait incomplète, si le rapport annuel n'insistait pas sur la part qu'ils prennent, en dehors de leurs occupations, aux œuvres plus directement encore en rapport avec la défense nationale, dans les Commissions, dans les Œuvres d'assistance, dans les hôpitaux de la Commission Administrative ou de la Croix-Rouge, dans les services techniques des Instituts pour les questions de chimie, de radiographie, d'aérostation, de météorologie […].[23]

The situation of the university was presented in very similar optimistic terms. Fortified by its past achievements, trustful in its future, the university maintained faith in its high mission and contributed to the creation of an entirely purified moral atmosphere.[24] Until the end of 1915, the material conditions at the Faculty of Science were apparently satisfactory.

Nevertheless, the installation of a high range 380 mm. howitzer in Hampont (Moselle) in January 1916 changed the situation. This canon, a Krupp type SK-L/45 Max (which was called *le gros Max* by the inhabitants of Nancy) made Nancy and Lunéville its targets. Moreover, during the war, Nancy suffered severe air shelling by planes and dirigibles. These bombings were responsible for much of the destruction and deaths (the 101 bombardments of Nancy between 1914 and 1918 brought about 181 deaths and 310 injured).[25] In November 1916, the tone of the academic discourse did not change much. In his report, the biologist Lucien Cuénot explained that Nancy had effectively received several hundred bombs but he was very pleased about the limited consequences for the Faculty of Science: some buildings

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[22] Source: *Comptes rendus de l'université de Nancy*. See also Ibidem.

[23] Comptes rendus de l'université de Nancy, 1916.

[24] This was the whish expressed in November 1914 by the professor of law François Geny. *Comptes rendus de l'université de Nancy*, 1915.

[25] [Anonyme 1918].

suffered important degradations (broken glasses at the Chemical Institute, the Institute of Physics and the School of Brewery) and the bombardments imposed the holding of the *baccalauréat* exams in the cellars of the Faculty of Science; fortunately there were no losses among the students and the professors.

Lucien Cuénot was in fact over-optimistic: much of the destruction of the university occurred in 1917 and 1918. A ministerial decree of February 11th, 1917 ordered the closing of the university because of the bombing. In 1917, the laboratory of electrical engineering, which had benefited from an expensive development thanks to Solvay, was hit by a torpedo and was almost totally destroyed. On October 31st, 1918, two incendiary bombs partly burnt down the University Library destroying 56.000 out of its 113.000 books.

The University library after the fire[26]

Actually, the last months of the conflict and its consequences were to be catastrophic for the University of Nancy and its faculties. First of all the heavy losses led to a demographic bleeding of the faculty of science and its technical institutes (see Table 4 below). After the war, because of the destructions suffered during the war, the financial needs of the faculties and of the engineering school were enormous. Two problems had to be faced: the level of financing (which had not evolved for thirty years) was identical to that of 1914 and was therefore insufficient in face of prevailing inflation ; moreover, there wasn't enough students and their fees (especially those paid by foreign students) could not cover the reconstruction expenditures.

[26] Photo Dufey, reproduite dans *Nancy sous les obus, images de guerre*, Nancy, Albert Barbier imprimeur, 1918.

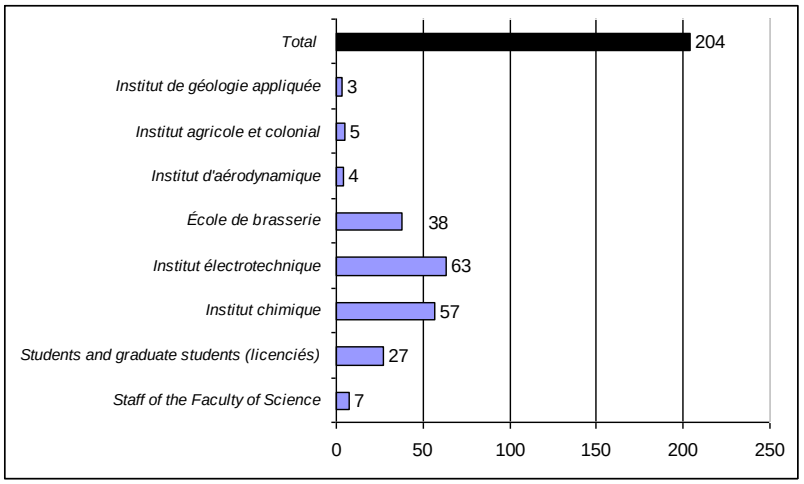

Table 4 – The human losses of the war for the Faculty of Science

At the end of the war, the municipality urged the University to reopen and to follow the example of Lille where the consequences of the war were far more important. In a decision of December 14th, 1918, the municipal council allowed 15 days for the official procedures of reopening. Furthermore, it enjoined the Faculty of Arts to restart French courses for foreign students and asked the government for a quick demobilization of the professors.[27] This demobilization was very disappointing for Nancy because of its slowness[28] and also because of the return of Alsace-Moselle to the French fold. The reopening of the University of Strasbourg offered very interesting opportunities for many professors from Nancy. As a consequence, Paul Müller (physical chemistry), Louis Hackspill (industrial chemistry) and Edmond Rothé chose to pursue their career in Strasbourg. As we shall see, the departure of the latter coupled with the death of Floquet in 1920, probably signed the death warrant of the pursuit of the aerodynamic course in Nancy.

IV. Some consequences of the war: the short-lived *Institut d'Aérodynamique et de Météorologie*

The central role of the technical institutes in Nancy favoured a strong cooperation between 'applied' and 'pure' disciplines. Before 1914, the project of an Aerodynamic Centre launched a strong collaboration between mathematicians, physicists and engineers. It also mobilized advanced partnerships with the army and civilian associations.

On July 12th, 1914, on the military aerodrome of Villers-les-Nancy, the *Société des Amis de l'Aviation* officially presented to the army two double aviation hangars and a workshop

[27] Procès verbaux des délibérations du conseil municipal de Nancy, 1918, pp. 250-253.

[28] After the armistice (November 1918), the Faculty of Science organized several courses for 35 students of the American army: wireless telegraphy (Camille Gutton), applied geology (Jules Thiébaut) and aeronautics (Vogt).

hangar for the maintenance of aeroplanes.[29] This donation, which represented 105 000 francs, was made possible thanks to several grants and subscriptions obtained by the association since 1912: the cities of Nancy and Saint-Dié (Vosges) gave important subsidies, so did the *Société Générale des Étudiants de Nancy* and journals such as l'*Est républicain* and l'*Étoile de l'Est*. These solemn festivities were conceived as part of the celebrations of the French National Day of July 14th (involving official and public torchlight processions, republican banquets, etc.). The hangar ceremony was followed by another donation from the *Société des Amis de l'Aviation* to the University of Nancy: a five-hectare ground for the construction of a future *Institut d'Aérodynamique et de Météorologie*, next to the military buildings. The inauguration speeches were pronounced by the Minister of Public Instruction, Jean-Victor Augagneur, and by the originators of the project, Edmond Rothé and Edouard Floquet.

Actually this ceremony was the result of a long commitment of the two professors. On March 20th, 1912, the Republican Union of Nancy invited Paul Painlevé for a public lecture on aviation. At that time, Painlevé was both a member of the Academy of Science, a deputy for Paris, the president of the *Commission Nationale d'Aéronautique* and the vice-president of the *Ligue Nationale Aérienne*.[30] He was accompanied to Nancy by captain Albert Étévé – who was then chief of the school of military aviation in Versailles – and by the lieutenant Jean Étienne Cheutin.[31] During his lecture, Painlevé talked about several aspects of the necessary development of aviation in the province; indeed, the army needed more aeroplanes but also aerodromes and hangars. After this lecture, a hangar committee was created by Floquet and Rothé with the double purpose of raising funds and buying a large field near Nancy. A few days later (April 7th and 8th), the *Ligue Aérienne de* l'Est, which was chaired by Floquet, organized on the aerodrome of Jarville (a village close to Nancy) a meeting in favour of military aviation. This event furnished the occasion for the merger of the league and the hangar committees since the two boards partially consisted of the same members and shared the same objectives. The result of this merger was a new association, the *Société des Amis de l'Aviation*, whose aims were to promote aviation in Nancy – especially military aviation – through the establishment and the installation of aerodromes, the construction of hangars, the creation of an aerodynamic institute and the organization of aviation contests and festivals.

The passion of Rothé and Floquet for aerodynamics and the promotion of aviation was quite old. Since his nomination in 1905, Rothé's researches were focused on this domain and the third part of his physics course was devoted to aerology and aerodynamics [Rothé 1917].

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[29] This aerodrome had been created in 1913. At the beginning, its squadron was made of 6 Farman planes.

[30] The league was presided by René Quinton and gathered several members of the Academy of Science, such as Paul Appell, Jean Bouquet de la Grye, Pierre Léauté, etc.

[31] Albert Étévé (1880-1976) and Jean Etienne Cheutin (1880-1938) were two pioneers of military aviation. Cheutin had been of the first to obtain his pilot's licence (licence n° 233). He left active service in 1932 with the rank of general. Étévé was at the time of his conference in Nancy the director of Versailles' military aviation school. As an engineer in aeronautics he developed various important devices such as an anemometer (anemometer Étévé) or a machine gun turret (*système* Étévé). He was to become a general inspector of aeronautics during the Interwar period.

Moreover, Floquet, as founder and director of the *Ligue Aérienne de l'Est* (later continued as the *Société des Amis de l'Aviation*), spared no effort in setting up aeronautics in Nancy. In 1909, the organization of the very ambitious *Exposition Industrielle de l'Est* in Nancy provided him the occasion to propose to the *Commission Permanente Internationale d'Aéronautique* the candidature of the town as the venue for the IVth international congress of aeronautics. This event lasted 5 days (from September 18th until September 23rd) and was accompanied by several displays of air navigation (especially that of the dirigible "La ville de Nancy", which appeared to have been a severe fiasco).[32] In 1909-1910, Floquet actively campaigned for the choice of Nancy as a staging point of the *Circuit de l'Est*, an important aviation race "Paris / Toyes / Nancy / Charlevilles-Mézières / Douai / Amiens / Paris" organized by the journal *Le matin* and rewarded by a 100 000 Francs prize. This event took place in Nancy during a sports week (from August 7th until 14th) and was linked with an aviation festival ending with a cavalcade and the crowning of the aviation queen.[33]

The board of the *Société des Amis de l'Aviation* chaired by Floquet (Rothé being in charge of a technical secretariat) brought together military officers (colonel Lecomte) and local economic, social or political leaders, such as the glass-artist Antonin Daum, Villain (the president of the very influential *Société Industrielle de l'Est*) or Brun (who was adviser on foreign commerce). The idea of creating an aerodynamic school in Nancy was initiated by Rothé with the aim of creating a framework favourable for a rapprochement between the Army and civilian organizations. Rothé clearly expressed this aim in an article of the *Est républicain*:

> Ce qui donne en effet à la création du Centre de Nancy un caractère tout particulier, c'est que ses fondateurs ont eu l'intention de faire d'abord une œuvre militaire en dotant Nancy d'escadrilles et de hangars de premier ordre, et aussi une œuvre civile d'enseignement général en aidant la Faculté des sciences à créer un nouvel Institut doté de cours, de laboratoires de recherches et de postes d'observations. A cet effet, au voisinage de l'aérodrome militaire, la Société a remis à l'Université de Nancy un terrain sur lequel seront édifiés les bâtiments du nouvel institut. Les officiers de l'escadrille y auront librement accès pour y faire les observations et expériences qu'ils jugeront utiles.[34]

The conclusion of the article was quite clear concerning the patriotic dimension of the event: "In the presence of the progress achieved by Germany, of the threats of German aviation, our Society will be keen to arouse new contests, new subscriptions".[35]

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[32] [Commission Permanente Internationale d'Aéronautique 1909].

[33] Archives municipales de Nancy, (k) I-11.

[34] [Rothé 1914 (11 juillet)].

[35] *Ibidem.* In 1910, the letterhead of the *Société Nationale Aérienne* contained the following injunction: "Join the league, enrol your parents, enrol your children […], the German Naval League has a million members".

Allegorical plate of Victor Prouvé for the inauguration of the *Centre d'aérodynamique*: "Beyond the Clouds, for Peace"[36]

What was the position of the Army concerning the development of aeronautics in Nancy? The military authorities largely took advantage of the popular fascination for aeronautics. A national fund was launched to support the development of military aeronautics in France. In 1912, colonel Edouard Hirschauer[37], who was then the permanent inspector of military aeronautics, concluded his official report concerning the strategic organization of French air squadrons by stressing the mobilization of several cities such as Nancy:

> Beaucoup de Municipalités ou de Départements ont apporté leur concours à la souscription nationale pour l'Aviation Militaire sous forme d'offres de terrains d'atterrissage et de hangars. D'autre part, le Comité de souscription paraît tout à fait désireux de consacrer une partie des fonds de la souscription au développement de cette organisation. C'est ainsi que déjà la ville d'Arras a élevé un hangar sur le terrain de manœuvres, que la ville de Bar le Duc a acheté un terrain et y a fait édifier des hangars, qu'à Nancy le Comité local se propose également d'avoir son terrain, et ses hangars, etc… Il suffit d'encourager ces mouvements, de les canaliser afin d'avoir ces terrains et ces hangars jalonnant les principaux parcours à travers la France pour posséder un outil aérien tout à fait remarquable.[38]

[36] Menu of the banquet of July 1918, 12th. Archives municipales de Nancy, 1 I-302.

[37] Auguste Édouard Hirschauer (1857-1943) was one of the fathers of modern military aviation. During the war, he gained major successes during the battle of Craonne in 1917. After 1919, he retired the army and began a political career as a senator.

[38] Service Historique de l'Armée de l'Air, AA 13163, doc. AA5.

In 1912, the priority for Hirschauer was the strategic separation between what he called school centres (with the finest equipment), depot centres and annexes. At the time Nancy did not appear as a possible school centre and Hirschauer proposed to develop the Châlons and Avor camps, Pau and Versailles Saint-Cyr). A year later, in another report, he nevertheless estimated the military part of the cost of constructing Nancy's aviation centre at almost 86 000 Francs. This amount was nothing in comparison with the estimated costs of the aviation centres for Dijon, Versailles or Lyon (more than 500 000 Francs for each).[39]

The project for an institute of aerodynamics and meteorology was first elaborated by Rothé and became a reality in November 1912. As director of this school, he also obtained in June 1913 the creation of a *diplôme d'études supérieures aérodynamiques* which could be delivered after a one-year degree course. One of the aims of this new diploma was to train plane designers and aviators.

> L'enseignement de l'Institut convient à tous les étudiants qui s'intéressent à l'aéronautique dans le but d'entrer dans les maisons de construction ; il est utile aux officiers qui désirent être versés dans les troupes aéronautiques et aux jeunes gens qui veulent y accomplir leur service militaire ; il répond en effet au programme théorique du brevet de pilote militaire.[40]

In 1912, amongst the 37 students, several possessed an engineering diploma from the institute of electrical engineering and applied mechanics and 8 were non-commissioned officers or officers.[41] In the absence of a specific building on the aerodrome of Villers-les-Nancy, the courses took place in the mathematics and physics institute. Floquet was in charge of general lectures about aeronautics. Rothé taught aerodynamics, meteorology and wireless telegraphy. Edouard Husson dealt with aeroplane equilibrium and the different types of flight. The curricula also consisted of lectures on engines and screw-propellers (Hahn), on strength of materials (Dumas), on electrical engines (Mauduit) or on meteorology (Marsal). Simon and Guéritot proposed some physics and mathematics classes. The training was completed by several demonstrations on the aerodrome of Villers-les-Nancy (planes, engines or kites) and a talk by Captain Loubigniac[42], the chief of Nancy's air squadron.[43]

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[39] Service Historique de l'Armée de l'Air, AA 13163, doc. AA14

[40] Discourse of the chief education officer Charles Adam, *Comptes rendus de l'université de Nancy*, 1913, pp. 143-144.

[41] In 1913-1914, the War Ministry would send 3 lieutenants to the institute (Frelut, Guillemin and Rigaut).

[42] Marie-Joseph Loubigniac (1877-1937) joined the army in 1895 as a private soldier (2nd class dragoon). He made a quick career. In 1912 he was obtained the rank of captain and was assigned to the service of aviation. He organized the aviation centre of Épinal and his results were highly praised by general Hirschauer. In 1913, he then moved to Nancy to achieve the same task. During the war he worked in the staff headquarters of the War Ministry. The end of his military career was almost entirely devoted to the development and administration of aeronautics.

Engagé volontaire en 1895 avec un grade peu élevé. Progresse rapidement dans l'armée. En 1912, il organise le centre d'aviation d'Épinal avec un résultat qui lui vaut les félicitations du général Hrischauer. En 1913 il s'occupe de Nancy.

[43] Comptes rendus de l'université de Nancy, 1913, 1914 and 1915.

Since the beginning of the aeronautics institute project, Rothé defended the idea that the teaching of aerodynamics had to be coupled with the teaching of meteorology. According to him, these two sciences shared historical and conceptual relationships; moreover, inasmuch as the aim of the institute was to train aviators and plane designers and constructors, this association was all the more crucial. In the introduction to the 3rd volume of his *Cours de physique* devoted to aerology and aerodynamics Rothé recalled his teaching in Nancy:

> Je disais vers la même époque à mes étudiants de Nancy, futurs aviateurs : « C'est aujourd'hui un devoir pour les physiciens de se tourner vers la physique de l'atmosphère et d'apporter une contribution à l'aviation par des recherches nouvelles, recherches qui ne pourront être fructueuses que par une collaboration étroite entre l'aviateur et le physicien ».[44]

He pleaded for a methodological and experimental shift to meteorology in order to propose solutions to the problems raised by the development of aviation (« Il faut chercher à résoudre les problèmes que les aviateurs nous soumettront ; il faut en particulier tracer la carte de l'air, comme on a tracé la carte marine… »[45]). His point of view was far from the romantic visions of the beginnings of aviation and he emphasized the fact that most of the heavier-than-air pioneers were engineers and that the first aeronautic feats relied on previous studies concerning birds, gliders or kites. Rothé insisted on the experimental nature of his teachings in aerodynamics and the only notions of mechanics introduced in his book were those that were necessary for the understanding of experimental methods. He was clearly conversant with the most important works on the resistance of air (Eiffel, Dubuat, Joukowski, Levi-Civita and Villat) and propounded a theory of the flow of air along surfaces. He also commented the fundamental formula of the theory of resistance of air,

$$R = KSV^2,$$

where *R* is the resistance, *S* the surface and *V* the speed. The constant *K* depends of temperature, pressure and hygrometry. Rothé argued that with this constant, we can see the fundamental link between aerodynamic and aviation because the characteristics of a plane must be measured under standard atmospheric conditions:

> Le fonctionnement du groupe propulseur, moteur et hélice dépend de ces facteurs [pressure, temperature and hygrometry] à un point tel que les essais d'un avion ne doivent pas être effectués dans des conditions quelconques ; ils doivent se ramener à des conditions type, à une atmosphère dite standard.[46]

A few weeks before the beginning of the war, Floquet and Rothé were very confident about the future of the aerodynamic institute. The project was supported by the University, the municipality, the economic leaders, the War Ministry and the Public Instruction Ministry. The architect E. André, who was in charge of university buildings[47], had proposed a 18 500 Francs detailed estimate for the construction of the buildings near the hangars of Villers-les-Nancy.

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[44] [Rothé 1917], p. VII.

[45] *Ibidem*, p. VII.

[46] *Ibidem*, page X.

[47] [Choffel-Mailfert 2007].

Rothé obtained a 20 000 Francs subsidy from the municipal council. André's estimate was approved on June 1st both by the chief education officer Charles Adam and by… Floquet (the dean of the Faculty of Science).

The war put an end to this project and the building never saw the day. After the war, Rothé went to Strasbourg and the institute existed only virtually through several courses. The airforce left the aerodrome of Villers and created its own meteorological stations. In 1920, the *Société des Amis de l'Aviation* was moribund: it still counted 214 members but on July 9th, 109 members voted in favour of its dissolution. Floquet was appointed as a liquidator and he decided to give the remaining money (10 000 Francs) to the Faculty of Science.[48] He died on October 7th 1920.

V. Conclusion

1914-1918 constituted a turning-point for the University of Nancy. The *Belle Époque* which was characterized by a strong intellectual effervescence and claims of modernity was followed by a very difficult period. After 1918, the Faculty of Science had to face serious obstacles: many professors left for more attractive posts at the University of Strasbourg. These departures weakened Nancy's scientific institutions which, during interwar years, had to grapple with demographic drain and financial crisis.

An important consequence of the war was the emergence of new strategies centred on the development of engineer training geared to local or regional needs. Before 1914, Bichat, Haller or Floquet fervently stressed the patriotic dimensions of the shift towards applied sciences and aeronautics; these developments were part of an avant-garde national and international strategy. After the war, ambitions became much more modest. Following the recommendations of the ministry enjoining universities to reinforce their links with local industry, a new *Institut Métallurgique et Minier* was created at the Faculty of Science in 1919. It was conceived as an adaptation to the needs of regional industry and was partly financed by the Nancy Chamber of Commerce and Industry.[49]

The short historical sketch presented in this article highlights the crucial role played by several individuals. Floquet's death and Rothé's departure to Strasbourg definitely closed the aeronautics parentheses.[50] Nevertheless, independently of their importance, it appears that in 1918 only the older and the more solid academic institutions were able to survive; this was the

[48] Archives départementales de Meurthe-et-Moselle, 4 M 86.

[49] Paul Petit, who was the dean of the Faculty of Science in 1919 thus declared: « Jusqu'ici l'État n'est intervenu en rien, ni pour la première installation, ni pour le fonctionnement de l'Institut métallurgique et minier ; nous espérons que cette création semblant répondre tout à fait aux vue exprimées par M. le Ministre de l'Instruction publique, celui-ci voudra bien accorder largement son appui financier au nouvel Institut, comme aussi aux autres Instituts, constitués dans la même pensée d'adaptation aux besoins de la région. » *Comptes rendus de l'université de Nancy*, 1919.

[50] As for him, Vogt chose to concentrate on the development of electrical engineering as a director of the school of electricity and mechanics and Husson apparently did not try to resume the aeronautics projects.

case for most of the engineer training institutes created in the 1880's, the 1890's and the 1900's but not for the more recently created *Institut d'Aérodynamique et de Météorologie*. In 1929, the Faculty of Science asked the minister of aviation for a chair of fluid mechanics in the name of the institute of aerodynamics but that was obviously too late…

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