

Auguste Choisy, engineering student: a technical training with a pinch of human and social sciences

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Auguste Choisy began to attend the *Ecole Polytechnique* in November 1861, where he remained a student until 1863; he then attended courses at the *Ecole des Ponts et Chaussées* over the next three academic years, from 1863 to 1866. In this article, we wish to review his training as an engineer, by examining more specifically the training he received in the disciplines that were to acquire the greatest importance in his subsequent career: architecture, construction and graphic arts, on the one hand, and his training, minimal but no doubt influential, in disciplines from the realm of the human and social sciences, on the other hand.

«Le Verrier's School»

However prestigious the *Ecole polytechnique* might have been, since its creation and throughout the 19th century, the life of this institution was not a long quiet river, and the institution was on several occasions in the course of its history not far from disappearing altogether.¹ The initial *Ecole polytechnique*, shaped by Gaspard Monge, was very soon replaced, during the Restoration, by the «Laplace School» where mathematical analysis was made the queen of disciplines.² But from the 1830s onwards, criticisms began to emerge against a form of teaching deemed too theoretical in an engineering school. Expressions such as «*Ecole monotechnique*», «lesser double of the *Ecole normale*», flourished to flay «the fateful inspiration of these men³ who know no other language but algebra, no other science but algebra, . . . who built a school of mathematicians, a school of higher education entirely devot-

ed to algebra. They abolished all courses in applied disciplines . . . experimental physics disappeared . . . machine mechanics disappeared» (Olivier 1851, XI–XII). It is partly as a result of this drift in the teaching at the *Ecole polytechnique* that the *Centrale* School of Engineering (*Ecole Centrale des arts et manufactures*) was founded on the initiative of Théodore Olivier, who had authored a number of the caustic expressions quoted above.

In view of the increasing gap between the teaching provided at the *Ecole polytechnique* and that offered in schools of applied disciplines, and following the stronger criticism expressed during the Revolution of 1848, a commission was appointed in 1850 with a view to propose a teaching reform. The president of the commission was the chemist Louis Jacques Thenard (1777–1857) and the reporter was the astronomer Urbain Le Verrier (1811–1877), whose scientific prestige was considerable in those days.⁴ The «Le Verrier Commission» endorsed the criticisms voiced against the over-theoretical and abstract approach of teaching at the *Ecole polytechnique* and proposed far-ranging reforms. In particular, it recommended entrusting the teaching to engineers, in as much as possible, and avoiding any theoretical development so as to conserve only what might be usefully applied. The reforms recommended by the Commission were set up in the 1850s but did not for all that allow the return of the Monge's school. As Bruno Belhoste has analysed, the Le Verrier School is not what the founder had wished. In the initial project, the courses in applied disciplines depended entirely on the teaching of general methods. This is why the curriculum gave theoretical sciences the primary role. In the new School on the other hand, the particular needs of practice determine the direction of general teaching. The programmes leave aside questions that deal with pure theory and emphasise knowledge that will come in useful for the future engineer. This change indicates a shift in the centre of gravity of the polytechnician's curriculum towards those of schools teaching applied disciplines» (Belhoste 2003, 228).

The domination of mathematical sciences did not disappear for all that and the reform did not lead to major changes in the teaching schedules. Measuring the importance of disciplines according to their weighting in the final examination, noted a slight decrease in the relative importance of analysis and mechanics in favour of descriptive geometry and geodesia for first year students, and ancillary subjects in the second year, such as architecture (Belhoste 2003, 225–6).⁵

While it is more a question of marginal fine-tuning of rather than a true upheaval in the curriculum, the particular spirit that existed had indeed changed. When Choisy was appointed at the *Ecole polytechnique*, ten years after the Le Verrier report, he joined a school that had undergone major remodelling compared to what it had been in the first half of the century, and whose general philosophy was no longer that of Laplace and Cauchy.

Léonce Reynaud and training in architecture

Choisy was not an architect but did receive solid training in architecture during his engineering studies, like all his fellow students. Initiation to architecture at the *Ecole polytechnique* has been a tradition ever since it was inaugurated. It is worth remembering that when the *Ecole centrale des travaux publics* was created—which was going to be given the name of *Ecole polytechnique* only a year later—it comprised three divisions, which went by the respective names of «Stereotomy», «Architecture» and «Fortification». Though an ancillary discipline, architecture nevertheless retained a true importance until the 1870s. This was particularly true over practically three-quarters of a century, between the time of the creation of the School and the end of the Second Empire, given the fact that only two professors, both endowed with strong personalities, had held this chair: Jean-Nicolas-Louis Durand, professor from 1796 to 1837, and Léonce Reynaud, who succeeded him until 1867.

In her analysis of the time devoted to the study of architecture, Simona Talenti notes the decrease in the number of lectures in 1811, which is no surprise in the «Laplace School», followed by their increase in 1850 in accordance with the instructions of the Le Verrier report (Talenti 2000, 64). This number was to decrease again in the 1870s and, at the beginning of the 20th century. During the period of interest to us, second-year students attended 40 lectures on architecture, of one and a half hour each, but Talenti estimates the total time devoted to architecture to be at least 180 hours, which is far from negligible.

When moving from the *Ecole polytechnique* to the *Ecole des Ponts et Chaussées*, students were unlikely to feel like a fish out of water since Léonce Reynaud taught in both institutions. While the course structure was the same as in the *Ecole polytechnique*, the training at the School of applied studies was more practical and down to earth, and involved a wealth of technical information. Students in Choisy's time spent about 400 hours on architecture over a period of three years and conducted projects right from the first year of study, general concepts having been acquired previously at the *Ecole polytechnique*.

During the whole middle third of the 19th century, the teaching of architecture for «X-Ponts» students was therefore stamped by the personality of Léonce Reynaud (1803–1880). He himself had had a tumultuous career beginning: he had joined the *Ecole polytechnique* in 1820 and had been excluded for political reasons in 1822, whereupon he had turned to architecture. After the Revolution of 1830, he was admitted on exceptional grounds to the *Ecole des Ponts et Chaussées* in 1831; he built the Bréhat lighthouse between 1836 and 1839, which ensured him a claim to fame. Appointed Professor of architecture at the *Ecole polytechnique* in 1837, and at the *Ecole des Ponts et Chaussées* in 1842,⁶ he pub-

lished the two volumes of his *Treatise on architecture* in 1850 and 1858; he was appointed Director of the *Ecole des Ponts et Chaussées* in 1869.⁷

During the forty years of his reign on architectural teaching at the *Ecole polytechnique*, Durand had imposed his rationalist, analytical and systematic method.⁸ With Reynaud, the geometrism of Durand was abandoned, taste and imagination in composition were recognised, and greater importance was granted to materials and construction in relation to composition. As a result, less emphasis was placed on architectural drawing, both at the *Ecole polytechnique* and at the *Ecole des Ponts et Chaussées*, where drawings were less detailed (Picon 1992, 576).

Reynaud kept the division of the course into two parts, which Durand had introduced: elements of architecture and building composition.⁹ While Reynaud granted construction and the resistance of materials a more prominent position than his predecessor, he did not for all that consider that construction completely determines architecture. And it is thanks to this distinction that architects can find room to manoeuvre. In 1860, Reynaud added a third module to his course, devoted to «concepts relating to communication networks», which was probably designed more particularly for future *Ponts et Chaussées* applicants (Talenti 2000, 65; Belhoste 2003, 277).

Finally, Reynaud developed a broader vision of architectural evolution than Durand, provided multiple examples and «[was] the first professor at *Polytechnique* to grant historical analysis any importance in the context of a course on architecture . . . Three of his lectures [were] entirely devoted to the history of architecture and he [made] sure to include . . . historical references whenever possible» (Talenti 2000, 65–66). This teaching of architectural history was in fact further developed when F. de Dartein and his assistant Choisy, succeeded Reynaud at the *Ecole polytechnique*.

Less doctrinal than that of Viollet-le-Duc, Reynaud's vision of history forecasts some of the essential points in Choisy's vision, «were it only for the importance given to the architecture of the East Mediterranean, and Byzantine constructions in particular, the contribution of which tends to be minimised by Viollet-le-Duc» (Guigueno and Picon 1996, 18–19). For Reynaud, «any system of architecture corresponds to a certain state of human science and is a consequence of it; since our science is essentially variable and gradual, it immediately follows that none of the systems of the past can be considered to have absolute value».¹⁰ This statement, obviously aimed at Viollet-le-Duc who viewed gothic architecture as the ultimate in construction, could have equally been made by Choisy.

While little is known about Choisy during the time that he was a student at the *Ecole polytechnique*, we do have some information about his results at the *Ecole*

des Ponts et Chaussées. Thus, at the end of his first year, he was awarded first prize for «various projects» in architecture, and at the end of his second year, for a project on a «marine government office building»; He was also awarded the first certificate of merit for construction, for a «comparative study of wood and metal gates for a navigation lock». At the end of his third year, he was awarded the first certificate of merit in architecture for a «construction project in view of the Universal Exhibition», first prize for construction, for a «project of river improvement» and second prize in agricultural hydraulics for a «project of land improvement».

We also know that Reynaud interceded directly to convince the school administration to allow him to pursue a mission of study he had started in Asia Minor.¹¹ While Reynaud developed rather strong links with his most famous student from a theoretical point of view, Vincent Guigueno and Antoine Picon are justified in underscoring that the links between them have remained difficult to unravel. While exerting what seems to be a rather direct influence on Dartein, Reynaud's legacy is more diffuse when it comes to Choisy, whose history of architecture owes as much to Viollet-le-Duc as it does to his professor (Guigueno and Picon 1996, 18).

La Gournerie's teaching

At the Ecole polytechnique, Choisy's professor of descriptive geometry during his first year, and stereotomy in his second year, was Jules Maillard de La Gournerie (1814–1883). Appointed at the Ecole polytechnique in 1833, La Gournerie had started teaching after having practiced as an engineer, thus meeting the wishes of the Le Verrier Commission.¹² Graduating from the Ponts et Chaussées in 1837, he had begun his career, as it turns out, under the direction of Léonce Reynaud, for whom he had worked as an assistant in the construction of the Bréhat lighthouse and produced all the stonework drawings. He then worked on the pier of Le Croisic harbour and the wet dock at Saint-Nazaire. He had just been appointed chief inspector of the Ponts et Chaussées when Reynaud, then a member of the Educational Board at the Ecole polytechnique, «remembering the young collaborator from Bréhat who so skilfully handled, after leaving school, methods that were not taught there» (Bertrand 1883, 94) offered him the chair of descriptive geometry in 1848 to succeed Charles François Antoine Leroy.¹³

La Gournerie's arrival on the scene was perfectly in line with the general current of ideas that followed from the Le Verrier report. The young Ponts et Chaussées engineer was in fact very critical of the way in which Monge had masterminded the teaching of the various disciplines for which he had become responsible. The founder of the School had organised the curriculum in tree-like

fashion, descriptive geometry representing one of the two main branches and giving rise to ramifications that corresponded to a multitude of applied disciplines: stone and wood carving, shadow tracing, perspective, architecture, machine drawing, etc. This organisation was never rigorously applied, architecture for instance not being amenable to the rule of descriptive geometry. But it had nevertheless left a durable imprint on the teaching of the other liege disciplines. La Gournerie questioned the very basis of this organisation, reproaching Monge for his purely theoretical and over-geometric approach to stereotomy in particular.¹⁴ The first major change that La Gournerie introduced in the curriculum for which he was responsible consisted in uncoupling the courses of stereotomy and descriptive geometry by having the former taught in the second year. Of course, the autonomy that goes with the teaching of stereotomy makes it possible to address more constructional problems, such as those pertaining to the quality of cements, and «to examine specific instances where cost reduction or greater ease of execution might force one to deviate somewhat from rigorous (geometric) techniques» (La Gournerie 1873, 262),¹⁵ a consideration that was totally absent from Monge's course.

La Gournerie also modified the mindset associated with the teaching of descriptive geometry. The ex-foreman of the Bréhat lighthouse considered that stereotomy is the discipline «which most requires the teaching of descriptive geometry, because it is its main application and because students who are familiar with the tracing of stonework and layout, and also happen to have sufficient theoretical knowledge, easily understand all the speculations of descriptive geometry» (La Gournerie 1855, 45).

In addition, staying as close as possible to the various graphical techniques used by artists, La Gournerie tried to clarify geometrical methods, case by case. It was no longer a question of singling out a general method, a universal graphic principle which he felt could only lead to a distorted vision of these so-called «fields of application». The goal was to present, and show the possible relationships between, the various graphical techniques of representation in space as a pallet of possibilities available to the user, far from any unifying theory that was bound to be simplistic. Presenting perspective, as did Monge, as an application of descriptive geometry was tantamount to going back to Alberti and Pietro della Francesca's «*costruzione legitime*». Though very general from a theoretical standpoint, this presentation presented serious practical problems compared to constructions with «vanishing points», which were not only faster to execute but also more pleasing to the eye. The latter methods were of course the ones that La Gournerie chose to present in his course.

Finally, between descriptive geometry and the representation of perspective, La Gournerie introduced several lectures on axonometry. Considered in Anglo-

Saxon countries and in Germany as the method of space representation best suited for engineers, axonometry is a subject of study in its own right. Now, not only does it not appear in Monge's lectures, either in the course on descriptive geometry or in its applications, but Monge, reusing the stone carving drawings from Jean-Baptiste de La Rue's treatise at the *Ecole polytechnique* as he had done at the *Ecole du Génie de Mézières*, systematically removed the axonometry that explained them and constituted the main contribution of the treatise compared to those which had been published over the previous century.

By introducing axonometry in his lectures, La Gournerie was not being terribly original but there again broke with the Monge tradition which had hitherto prevailed. And we know the benefit Choisy would eventually draw from this mode of space representation which, thanks to his teacher, had just regained its spurs in France.

Training in human and social sciences

The issue of teaching literature was raised practically as soon as the *Ecole polytechnique* was founded. The prerequisite of knowing Latin, which was established as of 1807, was finally abolished in 1855 but as of 1817, a French composition exam became part of the entrance examination and was maintained by the Le Verrier Commission.¹⁶

In the 1860s, the teaching of literature —French and German language— represented 17% of lecture time at the *Ecole polytechnique* and roughly the same proportion at the *Ecole des Ponts et Chaussées*. Judging by his results at the latter school, Choisy seems to have been «an engineer who knew how to write» even as a student: he was awarded first prize for literary composition in his first year and second prize the following two years. But we wish to mention here two specific courses which Choisy attended and no doubt influenced the young engineer: the history course at the *Ecole polytechnique* and the course in administrative law at the *Ecole des Ponts et Chaussées*.

History at the Ecole polytechnique

«Now, what am I doing here», exclaimed Victor Duruy as an introduction to his *Opening lecture to the history course at the Ecole Polytechnique*, which he gave on 6th November 1862. This was a question that a great part of his audience must have been asking themselves and the speaker was no doubt right to attempt to provide an answer.

Victor Duruy (1811–1894) had indeed just been appointed professor at the *Ecole polytechnique*, by the grace of Napoleon the Third, who wished to thank him for helping him write *La Guerre Des Gaules: Histoire de Jules César*. At the

time, Duruy already had a great deal of experience teaching history, which he had taught at the *Lycée Henri IV* and later on, at the *Ecole normale* from 1853, among other places. Being as inspector for the Paris Board (*Académie de Paris*), he had published a large number of manuals and several works on Antiquity, which made him a recognised authority on Roman antiquity. However, on 23rd June 1863, Napoleon the Third appointed him Minister of Education, which put an end to his brief history lecturing career at the *Ecole polytechnique*.

But while Duruy enjoyed the support of the Emperor, his nomination was also a general result of the policy wished for by the School and inspired by the Le Verrier commission. «Not only is there greater concern for recruiting candidates who already have a good literary education but there is also a will to improve such education within the School itself . . . The goal, already stated by the mixed commission, is to give them a broad education that befits their position within the State and society» (Belhoste 2003, 180). Duruy's course was therefore part of this rationale and it is not so much his nomination that is surprising but the fact that he did not have a successor.

Let us therefore hear Duruy justify his own nomination in front of young *Polytechnique* students:

Now what am I doing here? Ah! What a good thing it would be if I could perform it well: tell you what the past of the world has been and how modern civilisation was formed, so that, knowledgeable about the path it opened for itself, you in turn might push it forward, faster and better . . . It is a new discipline in this great institution and a gracious favour which the sciences are willing to make to the humanities (Duruy 1862, 4–5).

Those whose age has ripened the spirit or who, like yourselves have acquired early on the habit of serious thought, seek and find in history something else than a mere interest driven by curiosity. If it were only a matter of finding there a museum of interesting antiquities, the most vigorous spirits would not have made its narratives their constant preoccupation. It is first of all one of the most brilliant aspects in the art of writing and one of the noblest exercises in thinking . . . It is also the treasure of universal experience, because for all things, whether they be the most obscure, it is important, as one might say in administrative style, to study the history of the issue . . . Above all, it a great form of moral teaching .

The world has two oceans of facts and ideas. Dive into one of them and gauge its depth but let yourself be guided, albeit to the mere surface of the other, in order for your horizon to be broadened and your thoughts to travel far beyond, and to rise far above (Duruy 1862, 30).

These extracts give the tone of the lecture: a grandiloquent text, at times lyrical, a tad demagogical, but all in all less inspired than his author most cer-

tainly intended. Very positivistic, the text expresses unfailing faith in technical progress, in the hands of engineers, and remains at the same time highly moralistic.

The punch line of this introductory lecture is in the same vein:

It has been said that upon the death of one of the Kings of Persia, the candidates to the throne, far from tearing themselves apart, according to custom, agreed to reserve the crown for the one who would first see the sun, great god of the country, rise from the morning dawn. All turned their eyes towards the east; one alone turned the other way and, before the others, caught a glimpse of the first ray which, going over the thick mist of the eastern horizon, hit the zenith and streamed again in the west. Do as he did, gentlemen, so as to see better ahead, do turn and look back (Duruy 1862, 34).

Between 6th November 1862 and 14th April 1863, Duruy was to give 30 lectures (including the inaugural lecture) of one and a half hour each, at a rate of two a week. The content of the lectures has not filtered to us but thanks to the *Programme of the Ecole polytechnique for 1861–1863*, (A.E.P. 1862)¹⁷ we have at least some idea of the subjects covered. The programme was very broad, Duruy painting a general picture going from Western Antiquity to Europe, just before the French Revolution. As far as we can see, the twenty-eight lectures for which we have titles¹⁸ present European history, are not over-centred on France and are distributed as follows:

- The first three lectures bear on the philosophical systems of history and the geographical aspects that influenced the formation of societies
- The next four lectures are devoted to Antiquity (including 3 lectures on Roman Antiquity, Duruy’s special interest).
- Approximately seven lectures are devoted to the History of Gaul or France,
- One lecture and a half deals with the conquests of the Arab and Moslem world
- Twelve-and-a-half lectures present the history of European countries, notably England, Spain, Germany, Italy and Russia, to which must be added the American Revolution.

It is difficult to identify the subjects covered very precisely, merely from seeing the documents available, but one can nevertheless note the importance given to the history of religion, which is approached in 6 different lectures. We know in fact that before accepting the Ministry of Education, Duruy had refused the Ministry of Religious Affairs, which Napoleon the Third must have proposed advisedly, knowing that he was a fine connoisseur of the history of religion.

What influence could this course have had on the training of our hero? We have unfortunately no means of answering this question as we have no documents where Choisy addresses the issue, and no trace of a relationship between Duruy and Choisy. Nonetheless, the fact that this single history course happened to be given during the year when Choisy was a student remains a disconcerting coincidence. And the vast historical fresco, presented by an authority on Antiquity could only have seduced the young Choisy.

Law at the Ecole des Ponts et Chaussees

Similarly, Choisy arrived in the last year of his curriculum at the *Ecole des Ponts et Chaussees*, in 1865, when Leon Aucoc (1828–1910), Master of Requests, was appointed professor of administrative law. Member of the *Academie des Sciences morales et politiques*, Aucoc is now recognised among historians of law as one of the best authors on administrative law (Arabeyre et al. 2007). In particular, he has devoted one volume to the legal history of railways, where one can see «how the legislation of the 19th century accompanied early liberalism and was eventually transformed into interventionism under the dual pressure of development crises and industrialists» (Rolin 2009).

In his inaugural lecture (Aucoc 1865), in November 1865, Aucoc, unlike Duruy, did not need to justify the existence of his course as he was not the first to hold the chair. He nevertheless did, in a less grandiloquent and emphatic manner, more convincing on essence, providing more arguments and . . . more history. He began with a comparison, from the creation of the School to the time when he began to teach there (i.e. over more than a century), between the budget allocated by the State to civil engineering («*Ponts et Chaussees*») and the dizzying increase in such spending.

He then began to defend the existence of a course in administrative law:

How will you carry out your mission? Are you sufficiently prepared for it right now? Is it enough for you to have thoroughly investigated the rules of the art of construction, mechanics and hydraulics? Certainly not. You will not only be called upon to be skilful builders; you must also prepare, direct and follow, with all the financial and legal consequences this entails, the execution of works for which you have provided plans; and so you are the instruments, the organs of the interests of society in relation to the interests and the rights of individuals. In a word, you must participate in the administration and in the management of the affairs of the country: you therefore need to be instructed on the subject . . . [engineers] need to defend the interests of the State in controversies engaged in before various types of jurisdictions, civil courts, boards of regional governments, and the Council of State . . . You may have a vague idea about this; you must now have a precise idea of what this is (Aucoc 1865, 14–15).

He then reviewed the very history of this teaching, introduced at the *Ponts et Chaussées* in 1831, reviewed the content of administrative law, clarified the difference between law and morals, between natural law and positive law and finally presented the plan for his course. The first part was devoted to the organisation and attributions of public government, and to administrative authorities, comprising a historical and practical overview of the structure of authorities in charge of administering public works and of the organisation of the civil engineering body. The second part was devoted to the study of administrative subjects in which civil engineers have a part to play:

- Notions of civil law on the capacity of individuals, property and obligations.
- General rules about executing public works from three different points of view: public finance, the relationship with contractors, and the relationship with property owners
- Rules relating to the road infrastructure
- Rules pertaining to waterways
- Rules relative to steam machines and hazardous, insalubrious and uncomfortable workshops.

We have no more reports on any direct interaction between Choisy and Aucoc than we have between him and Duruy. But our historian of construction must have enjoyed the course since he got an excellent mark in his final examination.¹⁹

«It is no doubt one of the major virtues of Léon Aucoc to give sustained and enlightened attention to history in his teaching of administrative law. All his articles have a historical foundation» write Frédéric Rolin, and his introductory course at the *Ecole des Ponts et Chaussées* confirms this analysis.

One can thus see emerging in the curriculum followed by Choisy during his studies, a trajectory no doubt richer and more comprehensive than what might be stereotypically imagined to be the training of an engineer. On the one hand, following the Le Verrier report, the general philosophy on the teaching of science and technical courses had somewhat yielded, at the *Ecole polytechnique*, towards giving more attention to practical problems. La Gournerie's lectures, both on descriptive geometry and stereotomy, are good examples of this evolution from this point of view. But the lectures of Léonce Reynaud, whose influence on Choisy has already been underscored by Antoine Picon, Vincent Guigueno and Thierry Mandoul, also bear the stamp of this general trend. And, in the context of the course on architecture, the importance given to both construction and the history of architecture is also a means of meeting the demands of the Le Verrier Commission.

Aucoc's law course may have had a dual influence. First of all, it opens a perspective on the legal and social dimensions of construction and their determining weight on the choices of builders. As Robert Carvais has shown in this volume, Choisy shows consistent interest in these problems throughout his work; and one may well believe that this interest arose from this law course. On the other hand, Aucoc's course was, like Reynaud's but even more explicitly so, an example of the benefits of having a historical approach in order to understand a discipline. Finally, Duruy's history course complemented and reinforced the general training of engineering students who were lucky enough to have attended it. Even though we cannot unravel the inextricable tangle of criss-crossing influences that intervene in the training of an individual, it cannot be doubted that these various lectures seduced our young listener both in their essence and approach, and that he was able to gather honey from his initiation to human and social sciences as much as from the technical training he received.

Appendix

The programme of Victor Duruy's lectures in *The programme of the Ecole polytechnique, 1861–1863*

Opening lecture (Thursday 6/11/1862)

- 2 and 3. Examining the various systems of philosophy of history: The fatalistic schools (Thursday 13/11); Vico, Herder, Montesquieu (Saturday 15/11)
4. Of geographical influences on the formation of societies. Major aspects of general physical geography. Historical overview of the formation of French soil (Thursday 20/11).
5. The Orient and Greece. Expansion of Hellenic populations outside the mother land and vast colonisation system. Spirit of isolation, municipal selfishness; hate and need for a spirit of federation as causes of the ruin of Greece (Saturday 22/11).
6. Formation of the Roman republic: assimilation of the vanquished to the conquerors; equality established in the city between the various strata of the people. Public freedom —austere mores— grandeur of the state (Thursday 27/11).
7. Founding of the Roman Empire. Its organisation. Economic and political causes for its decadence and fall (Thursday 4/12).
8. Picture of the mores of Roman society. Moral powerlessness of Paganism. Advent and nature of Christianity (Thursday 11/12)
9. The Barbarian world. Mores and institutions of the Germans. The State of Gaul. The invasion. Characteristics of the Merovingian period (Thursday 18/12).
10. Grandeur of the Merovingian Franks, its causes, its fall. The Carolingians reconstitute authority and domination. Renewal of the Western Empire.

11. Charlemagne; his institutions, the roots of his power. Why and how his empire collapsed. Presentation of the feudal regime (Saturday 3/1/1863).
12. Complement of explanations necessary for understanding feudal society. The Arab invasion. Grandeur and decadence of the Khalifs Empire, Mecca (sic) (Thursday 8th Jan.).
13. Mohammed, the Koran. Islam dogma and worship. Current state of Moslem societies. Their inferiority with respect to Christian nations = causes (Sat. 10th Jan.).
14. The crusades = Results. Beginning of the papal-imperial struggle (Thursday 22nd Jan.).
15. Continuation of the papal-imperial struggle = Gregory VII; his reforms. The investiture quarrel. Fight for the independence of Italy with respect to Germany. Fight for the independence of the Holy Seat with respect to the Emperors. Results for Germany, Italy and Papacy (Thursday 27th Jan.).
16. Sat. 29th Jan. No summary (or no lesson?).
17. On the relationships between the two powers, spiritual and temporal: History of the French royalty from Hugues Capet to Philippe le Bel (Thursday 5 Feb.).
18. Quarrel between Boniface VIII and Philippe le Bel. The Templars. The Babylonian captivity. The Great Western Schism (Thursday 12th Feb.).
19. The state of Europe in 1328?? (date crossed out, strange in view of what follows). Conquest of England by the Normans and history of the country until the Battle of Bouvines (Thursday 19th Feb.).
20. Constitutional history of England since the Magna Carta. The Hundred Years' War. The political revolution in the fifteenth century in France, England and Spain (Tuesday 24th Feb.).
21. First period of the rivalry between the Houses of France and Austria. The Italian wars. Charles VIII, Franois I, Charles Quint and Soliman. Capitulation with Turkey (Thursday 26th Feb.).
22. Results of the Italian wars. The economic revolution: Christopher Columbus and Vasco de Gama, the beginning of great maritime trade. The Renaissance. Period prior to the Reform (Thursday 5th March).
23. The Reform. Lutheranism, Calvinism and Anglicanism. Differences between these three churches (Tuesday 10th March).
24. The Catholic Restoration in the 16th century. The Jesuits. The Council of Trent. Ambition and decadence of Spain (Thursday 12th March).
25. The war of religion in France and the Edict of Nantes. The grandeur of France, taking the place of Spain in Europe. Henry IV of France and Sully. Rebellion under the regency of Maria de Medici (Thursday 19th March).
26. Richelieu. He restrains the power of protestants and the aristocracy. He makes France predominant in Europe = 30 Years' War. Treaty of Westphalia and Treaty of the Pyrenees The English Revolution of 1648. Cromwell (Thursday 26th March).
27. Louis XIV (Tuesday 31st March)
28. The English Revolution of 1688. End of the reign of Louis XIV. England as a maritime power (Thursday 2nd April).

29. Of trade wars in the 18th century. The conquest of India and Canada by England = it colonial empire (Thursday 9th April).
30. Insurrection of the United States = consequences of this revolution for history in general. The destruction of Poland; Russia as a great power. Europe before the French Revolution (Tuesday 14th April).

Notes

1. Concerning the history of the *Ecole polytechnique*, see Belhoste (2003).
2. The process of change was initiated as early as 1806, hence the importance of the final qualifying examination, in which analysis —and Laplace— occupy a predominant position. Cf. (Belhoste 2003, 19).
3. Laplace, Poisson and Cauchy are more specifically targeted. The terms «algebra» and «analysis» were still used virtually without distinction at the beginning of the 19th century.
4. Le Verrier had defined the orbit of Neptune on the basis of disturbances in the orbit of Uranus in 1846; elected Deputy in the French National Assembly in 1849, Senator in 1852, he was appointed Director of the Paris Observatory in 1854.
5. The weighting for analysis and mechanics decreased from 40 to 35% while descriptive geometry and geodesia went from 20 to 26% in the 1st year and architecture went from 15 to 18% in the 2nd year.
6. He became visiting professor at the *Ponts et Chaussées* in 1842, and was given tenure in 1847.
7. Concerning Léonce Reynaud, see (Picon 1992, 550–563) and (Guigueno and Picon 1996).
8. Concerning Durant’s teaching at the *Ecole polytechnique*, cf. (Szambien 1984).
9. Talenti, who counted the number of hours spent on the course taught by Léonce Reynaud in 1861, comes up with 18 lectures on the 1st module (elements of architecture) and 15 lectures for the second module (building composition).
10. Léonce Reynaud quoted by (Picon 1992, 556).
11. It was after this mission that he wrote *L’Art de bâtir chez les Byzantin* [The art of building in Byzantine culture].
12. For La Gournerie’s teaching at the *Ecole polytechnique*, see Dhombres (1994) and Sakarovitch (1994).
13. C.F.A. Leroy had succeeded Hachette, when the latter had been shunted away from teaching under the Restoration. Having held the chair of descriptive geometry for 30 years, he had to some extent contributed to fossilise the discipline.
14. La Gournerie’s criticism, which was no doubt only partially justified, nevertheless gives a distorted idea of Monge’s vision concerning stereotomy. On this subject cf. Sakarovitch (2009).
15. Prony or Frézier gave a great deal of attention to these problems of approximation, which rapidly become unavoidable when one moves on to execution, and yet are not even broached by Monge.
16. See B. Belhoste, «La question littéraire» [The Literature Issue], in (Belhoste 2003, 176–181).

17. On this register, professors wrote down the content of their lectures, on a day-to-day basis.
18. The summary of lecture 16 is not given.
19. 24.7, which means he came 3rd in his promotion.

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