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# Napoleon I and Education in the Sciences: One Aspect of the Two Cultures in Conflict

Raymond J. Maras
*University of Dayton*

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Several years ago the position was taken that Napoleon's patronage of the sciences when weighed against the provisions for the teaching of science in the schools seems to be in the nature of propaganda. According to the research on the subject, science, under the Napoleonic aegis, was defined in a narrow, utilitarian manner and "any attempt to institutionalize a concept of science which went beyond this utilitarianism was immediately thwarted." Hence, Napoleon's contribution was merely to continue the close link between science and the military which the Revolution introduced. In fact, in Napoleon's regime "the pursuit of a scientific education was . . . tantamount to enlisting. . . ." Napoleon's reforms, it was further concluded, paradoxically brought about the reduction of science and thereby contributed to the continuous gap in France between the pure scientist and the skilled worker that has never been adequately filled.[1]

An investigation of the sources at the French archives and national library forces me to an entirely different conclusion. My thesis claims that Napoleon's educational structure, despite the pressures of reconstruction, war, and imperial expansion attempted to resolve the gap or disparity between the "two cultures"; in other words, the world of science and experimentation, including applied science, was approaching a position in Western culture that could not be retained in the traditionally inferior status; the accumulated evidence and successes of science abetted by a growing belief in progress and happiness during the past three centuries confronted a society (1789-1815) undergoing radical change. Thus the problem was posed and answered about the relationship and relative utility of the traditional studies in the humanities and education in the materially beneficient sciences along with their application. The National Convention (1792-95) was unable to deal satisfactorily with the problem; being faced with practical exigencies, it perforce emphasized the sciences, especially applied science, in its educational institutions. The following discussion and explication convince me of the credibility of my thesis.

In 1801 on the morrow of the French Revolution which left the nation's educational structure disunited, Napoleon, having secured his power at First Consul, proclaimed his intention of reforming the system of public schools, and charged a commission of distinguished men to prepare a comprehensive program of national education. On May 1, 1802, the government promulgated the law establishing a network of three

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successive stages of education: a structure of public primary schools, the intermediate lycées, and higher education in the special schools. The law placed education in the hands of a general director and laid the basis for a universal system of statewide education that still stands today. Apparently, Napoleon was the first modern ruler to successfully confront the problem which has been recently denominated as the "two cultures," that is harmonizing education in the arts and sciences (including technology) without tipping the balance in favor of one or the other in an irreparable and harmful manner with results detrimental to the best interests of society.

Napoleon was well-equipped to undertake the gigantic task before him. As a young, ambitious student he showed interest in the sciences, acquiring more than a smattering of various subjects. As a student at Brienne, he came under the influence of Etienne Bezout's text on mathematics so that some verses in the author's honor are attributed to Napoleon.[2] As an ambitious officer at Valence and Auxonne, he cultivated his scientific bent, studying such subjects as mathematics, mechanics, physics, chemistry, and astronomy; besides, he read copiously in biology becoming familiar with Buffon's writings and ideas. Despite this emphasis on the empirical and experimental sciences, it has been judged that Napoleon's educational formation was distinctively Cartesian: "Ce n'est qu' après avoir considéré intuitivement quelques propositions simples qu'il en conclut d'autres."[3] The geometric or deductive method still seemed to linger in scientific procedure in France at the time, a way that unbalanced hypothesis and imagination beyond empirical foundations. This method may help explain why Napoleon tried to impose his will on political and social realities rather than to work congruently with the data and norms of such reality as envisioned by followers of the natural law philosophy. In general, he received broad exposure in the sciences and humanities in addition to training leading to a military career. While Napoleon was more keenly curious about science as a young man, later on, as general and chief of state he continued to maintain interest in it; but being a practical man and a politician, he also looked for immediate applications of the sciences.[4]

Science, I contend, was to serve as the keystone in Napoleon's educational structure, especially on the higher levels. A survey of the institutions of science, either newly formed or traditionally supported, should present an adequate test or measurement and verification of my hypothesis. Napoleon's regime patronized science in the following institutions: the lycées in secondary education; special schools, imperial academies (which included the universities, the special schools, and lycées), faculties of science, the Ecole Normale, Ecole Polytechnique, various non-conventional centers of learning such as the Museums of Natural History, the Conservatories of Arts and Crafts, the Bureau of Longitudes, astronomical observatories, and numerous societies, among them, the notable Arcueil Society. Also it appears that the methodology underlying this cultivation of science was a combination of experimentalism, empiricism, and Cartesian rationalism. Undoubtedly, the scientists' basic philosophical orientation originated in the prevailing European philosophy of sensationalism and mechanism.

What was the condition of the lycées and the colleges, the basis of the educational infrastructure? It has been pointed out that one of the glaring weaknesses of the Revolution's legacy in education was the gap between the elementary and higher echelons of instruction. Since the program for the central schools projected in 1795 failed to flourish, Napoleon decided (following the coup d'état) to institute a nation-wide system of secondary schools or lycées.[5] Having been charged with the task in 1801 the planning commission comprising such scientists as Coulomb and Cuvier prepared a prospectus of instruction that placed stress on the physical sciences. Therefore, the law of May 1, 1802, provided for an emphasis on the sciences, particularly mathematics and physics. In 1804 Antoine-François Fourcrey (1755-1809), scientist and director of public instruction, addressed the government's general assembly indicating satisfaction with the growth, curriculum, and emphasis on science in the lycées. By 1808 some forty-eight lycées were organized. On the other hand, it has been noted that actually the sciences played a minor role in secondary education, and that the humanities dominated the curriculum. Yet, François Guizot (1787-1874), statesman, educator, and historian, acknowledged that the lycées had their "growing pains" but instruction in them was progressively perfected and surpassed the quality of instruction offered in the minor seminaries.[6]

A growing population and an expanding empire required additional lycées. Between 1805 and 1813 the number of lycées increased significantly; schools were opened in France and in the imperial possessions: Italy, Germany, the Lowlands, and Switzerland. Moreover, the decree of November 15, 1811, raised the number of lycées in the empire to one hundred, of which eighty were to be operating by 1812. Another decree of August 29, 1813, created twenty-three more in France and annexed territories; already in Paris in 1812 four lycées were operating and the city needed three more—it received four in addition to the expansion of the others. One should keep in mind that the communes erected 370 secondary schools by 1807 and apparently they were thriving.[7] Also, despite the competition from the public school program, private secondary schools continued to exist.[8] In curricula these schools were regarded as complementary to the subjects offered on the higher level (in the Faculties of Science). Thus the educational structure embodied in the lycées indicates a growing preoccupation with the sciences probably unmatched anywhere else in Europe. Unfortunately, for the further progress of the schools and science-education, the years 1812-14 witnessed catastrophic military reverses that spelled the doom of the first Napoleonic empire; nevertheless, his educational system though modified has endured to the present day.

What was the condition of higher education in the sciences? Article XXIII of the decree of May 1, 1802, stated that "the final degree of instruction would comprehend a complete and exhaustive study as well as the perfecting of the sciences and the useful arts." Article XXV represents the central intention apropos of the sciences; seven of the ten divisions of the article pertain to science; one of them specified the formation of thirteen new special schools of science: four in natural history, chemistry, and physics; another called for three medical schools; still another created two

special schools in the mechanical and chemical arts, and one in mathematics, and another in geography[9] The later law of April 11, 1803, provided for the establishment of three or more schools of pharmacy. Fourcroy, the director of education, held the prevailing position that the progress of civilization followed the growth of science. Undoubtedly, Napoleon esteemed science highly for its practical contributions to the welfare of the state and his regime.

The law of 1802 fixed the number of special professional schools and determined their curricula. During the subsequent four years the government completed organization of these schools: "each one devoted to a definite, practical task, each answering to a professional need clearly defined and generally understood; doing better without interference." The cardinal feature of these special schools lay in the greater specialization and more serious consideration given to each of the sciences for which the taste and talent disposed the student. These special schools provided the final stage of higher instruction: "l'étude complète et approfondie, ainsi que le perfectionnement des sciences et des arts utiles."[10]

Having adopted the concept of the special school, the regime's authorities also introduced it into the annexed, imperial territories. In 1805 the University of Turin was to include nine special schools, among them those of pharmacy, natural sciences, and pure and applied mathematics; the school of natural sciences was only the second one in the empire then; Paris' Jardin des Plantes was the other. Genoa also had its special schools. Parenthetically, the University of Turin, with its recognition of the principle that the institution must give service to the state, provided Napoleon with a model implemented several years later.

According to Guizot, by 1807-08 the various elements of public instruction had been instituted, but "success was lacking in the attempt to establish among them even the feeble ties that united them before the revolution." In short, the educational makeup in France lacked effective centralization. Also, "Aucune règle n'était établie sur les études préliminaires qu'on devait exiger de ceux qui se présentaient pour entrer dans les différents écoles spéciaux; aucune correspondance ne liait ces ecoles aux écoles secondaires." Hence, the Imperial University idea was superimposed upon the decentralized state of affairs. Louis de Fontanes, (1757-1821), author of an essay in verse form on astronomy and a classicist also, replaced Fourcroy in 1808. When he asserted that the country needed a single University and that this University required a single head, Napoleon is reported to have replied: 'It is so . . . , you understand me.'[11]

The law of May 10, 1806, established under the name of the Imperial University "un corps chargé exclusivement de l'enseignement et de l'éducation public dans tout l'Empire." It was to provide a centralized system of national education for the country, and would include under its supervision even the private schools. Fourcroy's discussion of the motives for the law forming a teaching body emphasized the need for physical sciences in education, primarily because of their utility.[12] Napoleon harbored similar views. The Legislative Assembly judged that the study of mathe-

matical and physical sciences was the complement of all liberal education, whether it be for the immediate utility, the extension of ideas, or the explanation of diverse natural and social phenomena, all of which it would be shameful not to try to comprehend. In 1808, but two years after establishment of the University, the law of March 17 organized the University and that of September 17 provided for its regulation. Article II of the latter decree assigned all public instruction dating from January 1, 1809, as belonging exclusively to the Imperial University. In addition, the statute of October 18 (in consequence of Article IV of the law of March 17) divided the University into thirty-two academies, each one a complete educational structure containing lycées, special schools, and administration. Between 1808 and 1813 at least seven more academies were added to the original number, and included academies in the Lowlands, Germany, and Italy.[13] These "academies" apparently were complete universities in the etymological sense of the Latin "universitas" meaning "all" subjects. Unfortunately, Napoleon's defeats in 1813 and 1814 made for the elimination of thirteen academies. The Bourbon regime of the Restoration further reduced the number of academies to seventeen besides restoring the name "university" to the institutions. With the second Restoration of the Bourbons in the summer of 1815, however, the term academy was restored.

The Faculties of Science for each academy were likewise created by the law of March 17, 1808. A year later such faculties existed in six French cities; by 1812 an additional eleven arose. Higher mathematics, mathematical and experimental physics, chemistry, and natural history were taught in these faculties, courses being one year in duration. The professors were subject to a rigorous criteria which the Council of the Imperial established on February 16, 1810. For example every professor was to be knowledgeable in the "history of science" [sic] which he taught and this included current bibliography. In whatever courses feasible, demonstrations and experiments were to be part of normal pedagogic procedure. Candidates for the doctorate in the Faculty of Sciences were to present two dissertations. It is interesting to read that the professor of geography was to present his science "dans ces rapports mathématiques, physiques, historiques et politiques, industriel et commerciaux. Il fera connaître la correspondance des noms et des lieux qui lient-elles la géographie ancienne et la géographie moderne."[14] Similar thoroughness was expected of professors in the other sciences.

The decree of March 17, 1808, organizing the Imperial University also established the Ecole Normale for the purpose of educating teachers in the sciences and letters.[15] Matriculants were obligated upon graduation to serve teaching terms of ten years. A subsequent decree of July 29, 1811, exempted all such graduates from military service. Article CXIII stipulated the following: 'ces aspirants suivront les leçons du Collège de France, de l'Ecole Polytechnique ou du Museum d'histoire naturelle, suivant qu'ils se destineront à enseigner les lettres ou les divers genres des sciences.' Moreover, scientific studies were required of all students during the first year of matriculation; the course of studies at the Ecole Normale lasted only two years, but an ambitious, successful student could continue studies leading to the doctorate. The

Council of the Imperial University recommended on February 1, 1811, that the Ecole propagate uniform principles of instruction and education: 'Elle peut seule former d'habiles professeurs, tenir l'enseignement au niveau des connaissances humaines et établir l'uniformité des principes."[16] As an affiliate of the Imperial University the Ecole Normale provided the official indoctrination. By 1813 all professors of higher education were required to undergo instruction there.

Numerous specialized institutions cultivated the sciences, it seems, even more intensively than did the formal schools. Among them were the Museums of Natural History, the Conservatories of Arts and Crafts, the schools of pharmacy and medicine, the astronomical observatories, a Bureau of Longitudes, the Ecole Polytechnique, and private societies such as that at Arcueil. Throughout his rule Napoleon manifested a great deal of leadership by his interest in the progress of science. At a time when the life sciences were developing their raison d'être, he focused much attention on the Museum of Natural History in Paris, for example by providing funds for the resumption and acceleration of projects previously interrupted during the Revolution; also, he increased the museum's land domain at a time which witnessed the multiplication of activities embracing instruction, collections for research, replacement of specimens, collections of living specimens in flora and fauna, and new construction including an amphitheater.[17] Under Chaptal's versatile ministry the museum flourished and despite deficiencies it was rated the most complete in Europe. Already by 1802 the museum was so well-organized and active that it offered instruction in the natural sciences. During the dark days of 1813, as Napoleon's armies were reeling from defeat in Germany, classes continued there while being suspended elsewhere. Thirteen professors presented their lectures. In addition, the museum's administration maintained correspondence with twenty-four provincial schools, with approximately 190 botanical gardens throughout France, and exchanged or purchased selected specimens from throughout the world. The Empress Josephine was unusually active in dealings with the museum. Several academies (universities) maintained museums of natural history; that in Turin contained a school of natural sciences. Museums of natural history were also established in various parts of the empire. Since the museum in Paris was the premier one on the continent, it received many distinguished visitors among them Tsar Alexander, various kings and princes with their entourages; even Napoleon and Josephine found time to visit the museum.

Another specialized institution was the Conservatoire des Arts et Metiers in Paris, combining the pure and applied sciences.[18] Founded during the Revolution it soon displayed as complete an array as possible of various scientific and mechanical apparatus illustrative of the progress of science and technology especially in France from the past three centuries. In short, it was a continuous exposition and reminder of the country's scientific and inventive genius. It also became part of the nation's educational structure. Additional conservatories were established at Châlons-sur-Marne, Beaupréau (transferred later to Angers), and at St. Maximinien near Trèves; the first included the school that was transferred from Compiègne upon Napoleon's dissatisfaction. Professor Williams saw such écoles as primarily trade schools teach-

ing elementary technical knowledge, mathematics, and physical science; on the other hand Charles Babbage of England praised the French government for establishing the Paris conservatory and for its lectures on the sciences as applied to the arts and manufactures. In Napoleon's time the Conservatory in Paris continued to be something more than a museum. There were professorships in chemistry and mechanics; qualified personnel were provided in agriculture, and the curriculum included both theoretical and practical subjects. Collections were continuously added to the museum's stores. Charles' celebrated physics collection was added under the empire. Champagny, minister of interior, sent a request to Hanover to obtain literature concerning the mechanical arts. Moreover, the Parisian institution became a "center of demonstration of the applied sciences." Laboratories and workshops were provided and facilities offered to poor but promising workers to carry out their investigations. Out of such an atmosphere and assistance there came Jacquard's textile loom in 1801 and Leblanc's later research on crystallography. The impetus to technology which the Revolution and Napoleon promised was bringing results. In 1810 Napoleon deemed it worthy of his time to visit the conservatory.

Success did not mark the activity of every educational institution. The Ecole Polytechnique, France's greatest school of applied science, failed to fulfill its glorious expectation.[19] The resolution of December 16, 1799, provided for the school's improvement along scientific lines. Article I of the resolution stipulated that the Ecole Polytechnique, founded during the Revolution, "est destinée à répandre l'instruction des sciences mathématiques, physiques, chimiques, et des arts graphiques, et particulièrement à former des élèves pour les écoles d'application des services ci-après désignés. . . ."[20] Articles XII and XIV placed emphasis on mathematics and the sciences, particularly their application. The council of improvement recommended that the special schools be restricted to applied science, their truly distinguishing mark. The Ecole was to enable the students to have the time and means to deepen their knowledge as well as to expand it; its general aim focused on a two year common foundation centering about mathematics and the sciences. Unfortunately, the law abolished the students' freedom to choose their own careers, a decision contrary to the Declaration of the Rights of Man and Citizen of 1789 which was substantially implemented in subsequent constitutions to 1795 but excluded in 1799. The Ecole was to be transformed "into a general school of advanced science . . . to instruct those who wished to cultivate the arts and sciences for their own use, or to use their scientific knowledge in civil pursuits."[21] The expanded curriculum thus was projecting the sciences to new heights of prestige. Theoretical chemistry and physics were stressed while an extensive mathematics program provided the basis for the more sophisticated study of the physical sciences. Despite this avowed new departure over 70 per cent of the graduates of 1799 entered the military service after Napoleon's coup d'etat—at this time France was at war with the second coalition. The process of militarizing the Ecole continued under Napoleon. The decree of July 16, 1803, concerning the organization of the Ecole transformed it into a veritable military academy as military studies supplanted the curricula in science. Louis B. Guyton de Morveau (1737-1816), a well-known scientist and director of the Ecole,

was replaced by a military man. By 1809 its students were subject to call and placement by the minister of war. Quality theoretical instruction suffered at the demands of immediate military requirements. In September, 1809, Montalivet, minister of interior, inquired as to how many students from the Ecole were selected for training in the special School of Roads and Bridges; it appears that some twenty-eight graduates had been requested that year but only seventeen were obtained. Perhaps as a result of this shortage, Napoleon's decree of August 30, 1811, pertained to the "passage des élèves de l'Ecole Polytechnique dans le corps de Génie et dans les services publics."[22] This was not really a new tack since as early as 1802 the school was preparing qualified candidates for various branches of the military and technical civil services. Thus, the Ecole launched with optimistic expectations, unfortunately because of war priorities, failed to fulfill hopes of freedom and large-scale scientific and technological excellence projected at the beginning of the Consulate. However, that had been, its plight fortunately did not coincide with the entire condition of French science.

The institutions developing and disseminating the sciences were imbued with an élan well-described by the philosophical terms of rationalism and empiricism and by the scientific procedural term of experimentalism. Ultimately all three were intertwined with the wider theory of nature then prevailing, the mechanistics-ensist philosophy. French empiricism probably owes its initial impetus to Voltaire upon his return from England where he encountered the new ideas in full force. It was further enhanced by the ideas of Condillac, best known for his epistemological sensism. In Napoleon's era the new philosophical tenets culminated with the ideologues, for example their ideas that man is a machine or an animal; in any case that man is purely material in essence. Collingwood appraises the new development as destroying the traditional view of substantialism, that is that natural life including man can be only understood through the concept of unchanging essences;[23a] but science was slowly departing from the old classical-scholastic tradition since transformism, that is evolution, was currently adumbrated as an explanation of organic life.

That experimentalism was the generally accepted procedure in France by Napoleon's time may be verified by numerous examples.[23b] There is the "crash" program which Napoleon established in the promise of discovering a medical remedy for the croup disease. The prize awarded 12,000 francs for the best memoir on the subject. Sustained research on the problem culminated in its solution in the late nineteenth century. Another example of experimentalism appears in the First Consul's establishment of a prize honoring discoveries in electricity and galvanism. Alexander Volta (1745-1827), inventor of the "pile" or storage battery, inspired the prize when he presented a demonstration of his discovery with Napoleon in the audience. Research in astronomy continued as seen in the establishment of the Lalande prize awarded annually to the scientist "qui . . . aura fait l'observation la plus intéressante ou le mémoire le plus utile au progrès de l'astronomie." Since the science of astronomy was very popular, a consequence of the marvelous contributions of Newton, Herschel, and Laplace, Napoleon provided funds for astronomical

observatories which under the empire existed in Paris, Marseilles, Toulouse, Turin, and Genoa. Moreover, the Bureau of Longitudes in Paris, a creation of the Revolution, employed four astronomers, two navigators, one geographer, and four assistants to the astronomers.[24]

Experimentalism further manifested itself in the development of innovative projects. Under the Directory there were appeals for special schools, one of which appeared in 1800 at Lyons. Chaptal provided the necessary funds for the school specializing in applied experimental chemistry "applicable aux procédés et au perfectionnement des arts et manufactures."[25] In 1806 a plan was presented for the establishment of a professorship in hydrostatics and hydrodynamics.[26] Such scientists as Bossut, Monge, Lagrange, and Prony were interested in the theory and subject matter; Marie Riche, Baron de Prony (1735-1839), was also absorbed with the practical applications. It is amusing if not revealing that the professor teaching the subject would have to teach transcendental mathematics, physics, chemistry, hydraulic architecture, and mechanics; he would also be expected to produce an elementary treatise discussing the sciences in their present state of development. Another innovation proposed the creation of a school of forestry which one writer regarded in 1807 as a necessity.[27] It is known that French-sponsored experimental stations existed in the United States at this time. In 1806, moreover, the Museum of Natural History established a school of agriculture reputed as the first of its kind in Europe; its purpose was "d'augmenter les moyens d'arriver à la connaissance de l'histoire naturelle des végétaux . . ." through experiment.[28]

Experimentalism, of course, pervaded the curricula of the Ecole Normale, which prepared the teaching faculty for the nation, and which was regarded as "en effet le complément naturel de ces Facultés (des Sciences et des Lettres); les uns donnaient les maîtres, l'autre fournissait les élèves; de leur collaboration dependaient le sort de l'Université."[29] The revised regulations (1809) in the Faculty of Sciences also affected the Ecole Normale by placing emphasis on mathematics and physics.[30] Article XIV required all students to take courses in general and experimental physics; Article XV required students majoring in the math series to take all four courses in mathematics: integral and differential calculus, mechanics, and astronomy. Articles XVII-XXI dealt with the life sciences. Courses meeting twice weekly for one hour lasted seven months. Article XXIX required demonstrations and experiments in all courses possible. The method of experimentalism and the philosophy of empiricism may also be illustrated in the activity of François Magendie (1783-1855), who had taken his medical training under the new system of medical studies which Napoleon instituted.[31] Trained in the new methodology he experimented with physiological, phenomena, espousing a theory of biological determinism—an operational principle which posits the tenet that "under identical conditions the resulting phenomena will be identical." He and later Claude Bernard, the physiologist, vindicated the experimental method for medicine. Such pioneering was multiplied time and again, having become an integral part of science's universality and standard procedure.

Since education per se is not confined entirely to the institutionalized systems of formal schooling, no matter how indispensable, one might therefore look beyond the schools to various societies to see what they were doing to promote the sciences. Napoleon's relationship to these societies, although not always direct, proved to be significant. Among the most important of these societies were the Society for the Encouragement of National Industry[32] and the Arcueil Society.[33] The former fostered research and practical application, placing French science within reach of the manufacturer and the tiller of land. The Arcueil Society may be the French parallel to England's Lunar Society, a group of scientists and practical men who helped fashion the scientific climate of opinion and contributed to the growth of science, technology, and culture in England and the world. For many years Berthollet and Laplace, the two motive forces at Arcueil, promoted experiment, provided a library, laboratory facilities, and occasionally obtained financial aid. Its most famous representative is undoubtedly Gay-Lussac, discoverer of the law of gases. A third notable society appears in the Société philomatique.[34] Actually Napoleonic France was dotted with numerous scientific societies in the departments: among them societies existed at Cherbourg, Grenoble, Poitiers, Mont-Tonnerre, and Ems-Supérieur.[35]

Perhaps an excellent landmark in the development of science in France may be that of the growth of the Institute of France. Its First Class of the Physical and Mathematical Sciences comprised eleven sections; those of geography and navigation being new. Napoleon favored the First Class by including two perpetual secretaries, one for the physical, the other for the life sciences, a greater number of correspondents than any of the other classes, and by adding the new sections. The Institute was France's grand and prestigious body, a kind of senate of science, signalling to the government the new discoveries and inventions, and supervising instruction. The Institute usually recognized the illustrious men of mathematics and the sciences by welcoming them to its membership or correspondence.[36]

Thus, Napoleon, as may be induced from the above accumulated data, established and supported a new national system of formal and quasi-formal education that disciplined the growing power, utility, and attraction of the new knowledge and methodology. To further promote the advances in secondary as in higher education, he proceeded with "crash" programs, awards, and prizes to stimulate training, research, and discovery. Indubitably, one of the grandest successes, but one rather short-lived and never fully developed, was the establishment of science as a keystone in French education. He and his counsellors esteemed the "two cultures," understanding their complementarity and appreciating their relative values.

University of Dayton

## NOTES

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18. *AN,* F$^{21}$659; F$^{17}$1139; F$^{17A}$1144; AF$^{*IV}$175, 329, 330; AD$^{VIII}$32; 0$^{2}$287. Georges Bouchard, *Guyton-Morveau* . . . (Paris, 1938), p. 360. Charles Babbage, *The Exposition of 1851* . . . (2d ed. aug.; London, 1851), pp. 23-25. Maurice Daumas, ed. *Histoire et prestige de l'Académie des Sciences* (Paris, 1966), pp. 11, 174-94.
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20. *AN,* AD$^{VIII}$32, dossier "L'Ecole Polytechnique," and extract of #1032 *Bulletin des Lois,* No. 338, pp. 1-4.
21. *AN,* AD$^{VIII}$32 for the "Rapport sur la situation de l'Ecole Polytechnique," (Paris, an IX).
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