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OFFICE OF NAVAL RESEARCH
LONDON, ENGLAND

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ALBERT BARCILON
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<p>A review of the characteristics of a unique system of higher education found in France: The "Grandes Ecoles." The report looks in some detail at the engineering schools in France and provides an overall view of French engineering.</p>		

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FRANCE'S GRANDES ECOLES

I. Introduction

In the last ten years the French university system has undergone reforms and radical changes which, at times, made the headlines in the press; yet, France's "Other" system of higher education, the "Grandes Ecoles," remained almost unaffected. Why is it that, in the same country and for two systems dealing with higher education, the reaction has been so different? To answer that question one must first understand what is a "Grande Ecole." I will try to present the reader with this concept; the task is difficult because this system, which is roughly 200 years old, has evolved like a living thing and spread to embrace many facets. I will also touch on how engineers are trained and the position they occupy after graduation.

Recently, while visiting a US laboratory, a graduate from one of these Grandes Ecoles was asked about his education. He replied that he studied in a "High School"! Although the latter is a literal translation from French, a "Grande Ecole" is far from being a "high school" as we know it in the States. It is an establishment of higher education whose purpose is to train highly qualified specialists in such fields as industry, business, engineering, the civil service or the military sciences. These Ecoles are a feature peculiar to the French educational system. Historically the oldest Ecoles were founded a few years after the French Revolution; many were founded by Napoleon who saw the need for highly qualified teachers and military and civil engineers. Note that the engineering profession started as a service to the military. A great many Ecoles were also started at the turn of this century when the Industrial Revolution initiated a proliferation of various technologies (see Appendix). At present, there are 144 Grandes Ecoles, about half of which are located in or around Paris. There are about 10,000 incoming first-year students in the Ecoles which represent some 10% of the entire first-year enrollment in the French university system. The total number of students in these Ecoles is about 40,000.

It is hard to compare these Ecoles with a similar education in the US. If, for the time being, we limit our attention to the engineering schools, one could compare the Grande Ecole training to, perhaps, the Master's level at institutes of technology such as MIT or Cal Tech,

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although the teaching drills and the entrance requirements of the Ecoles are quite unique. We can group the Ecoles into Public and Private Establishments. The Public Establishments, which number 104, can be subdivided into those that are tied to the "Secretariat d'Etat Aux Universités" (62 of them) and those that are tied to other Ministries (42); the Private Establishments, which number 41, can also be subdivided into those that receive support from the State and those that do not. Historically, Ecoles attached to a given Ministry were established to provide that Ministry with a pool of brain-power to draw upon. The "Ecole Supérieure des Mines," with campuses in Paris, St. Etienne, Douai and Alès, comes under the Ministry of Industry and Research and educates specialists in mining. The five "Ecoles Normales Supérieures," created by Napoleon, attached to the Ministry of Education, were originally supposed to train secondary school teachers; they reached such a high level of excellence, however, that they now train university professors, researchers and high level civil servants. The "Ecole Polytechnique," called for short "Polytechnique" or "X" (X, a symbol often used in mathematics, illustrates the heavy emphasis of theory found in the curriculum of this Ecole), is a prestigious institution attached to the Ministry of Defense, and trains "Ingénieurs de l'Armement." A student does his military service while attending the school; he wears a uniform and is under military rule. But, he need not become a professional soldier; he can serve as a civil servant in a number of government institutions. (President Giscard D'Estaing is a graduate of Polytechnique.) The "Ecole Supérieure de l'Electronique de l'Armée de Terre" and the "Ecole Nationale Supérieure de Techniques Avancées" are also attached to the Ministry of Defense.

The "Ecole Centrale des Arts et Manufactures," known for short as "Centrale" or "Piston" (slang), is attached to the "Sécretariat d'Etat Aux Universités." It is an old (1829), prestigious school that rivals Polytechnique. The "Ecole Supérieure d'Electricité," known for short as "Sup. Elec.," is also attached to the "Sécretariat d'Etat Aux Universités" but is a private Ecole. All these Ecoles award diplomas (Ingénieur Diplômé) with titles protected by the State. A graduate of an Ecole is not just a mechanical or an electrical engineer but is a mechanical engineer of the "Ecole Centrale" or an electrical engineer of the "Ecole Supérieure d'Electricité"!

Tuition fees of these Ecoles vary greatly. Many

of the Public Ecoles are practically tuition-free. In some, such as Polytechnique, a student is even paid a small stipend upon signing a contract promising to work for the government for the ten years following graduation. This contract can be waived if after graduation the "polytechnicien" specializes in another "Ecole de Spécialisation" or does research. If he decides to break his contract for, say, a job in industry, he must repay the government for his studies. At the present time this sum is roughly \$14,000, to be paid over a period of 6-10 years. Similar rules hold for the "Ecoles Normales Supérieures." Some of the private Ecoles, like "Sup-Elec," are heavily supported financially by several ministries so that their tuition is only about \$30/year. In other private Ecoles tuition can be as high as \$1000/year.

Graduates from the French university system do not have strong ties with their Alma Mater as most US graduates do. By contrast, the Grandes Ecoles, being very instrumental in forming the country's elite, provide the new graduate with a network of connections to alumni; these are in key positions in government and industry and tend to favor a candidate from their own Ecole. This is, no doubt, partly due to the fact that one is better aware of the program of studies of one's own Ecole and thus can better relate with the new applicant. People talk of the "Mafia de l'X" to denote the strong bond that exists between new and old graduates of Polytechnique. In that respect, the Grandes Ecoles tend to foster a sense of belonging to an Alma Mater similar to the one found in the States. I was told that there is a move to resist this sort of inbreeding, for people have realized that a mix of graduates from different Ecoles tends to enhance the exchange of ideas. In all Ecoles, the alumni have considerable influence on the running of the school and on its curricula. They sit on governing boards and provide an excellent feedback tying the needs of industry to the curriculum taught in these Ecoles.

Thus, since their creation, the "Grandes Ecoles" have been relevant and have filled a need in society. This relevance, along with the highly motivated student body, has done much to stabilize the system against the winds of change which blew over France during the last ten years.

There are various kinds of Grandes Ecoles and they can be classified into eight categories: Commerce, Veterinary Sciences, Agriculture, Science and Engineering, The Arts,

Education, Military Science, Civil Service and Political Sciences. Law and Medicine are not found on this list; therefore, one trains for these professions via the university system. In this report I will focus on the Science and Engineering Ecoles.

II. Entrance Requirements

Again there are a number of subtleties involved, for not all these institutions have the same requirements. This is best explained if I refer the reader to Table I.

TABLE I

	YEARS AFTER BACCALAUREAT				
	1	2	3	4	5
Ecoles Nationales d'Ingenieurs	✓	✓	✓	✓	
Instituts Nationaux des Sciences Appliquées	✓	✓	✓	✓	✓
Ecoles Nationales Supérieures d'Ingénieur	*	*	Δ	Δ	Δ
Other Grandes Ecoles	*	*	✓	✓	✓
Universities	Δ	Δ	Δ	Δ	✓

- ✓ "classical" engineering preparation
- Δ preparation tied to university
- * preparatory forms that train students for the "concours"

We first find a group of schools entitled "Ecole Nationale d'Ingénieurs" followed by the town in which the Ecole is located. For example, "Ecole Nationale d'Ingénieurs de Brest" etc. These schools recruit directly after the "Baccalauréat" on the basis of a "concours," i.e., a competitive examination, and, unlike some other Ecoles, they do not require special preparation for this concours. Their curriculum runs for four years and forms "practical" engineers who have spent a year in industry as part of their training. While in

industry the position occupied by a student engineer is entrusted to the school to supervise.

We then find the "Instituts Nationaux des Sciences Appliquées." Again, that title is followed by the engineering specialty and the town in which the institute is located (for example, "Institut National Supérieure de Chimie Industrielle de Rouen"). These institutes are public entities attached to the "Sécretariat d'Etat Aux Universités;" students are selected on the basis of their academic record possibly after an oral interview as well.

The "Grandes Ecoles," which include the larger and more prestigious ones, both public and private, rely upon concours or entrance examinations to select their candidates. The system is extremely selective for, in effect, there are two selections that take place. To prepare for these concours one enrolls in preparatory classes found in some of the larger lycées (high schools) which select only candidates who have obtained their Baccalaureats with A's. This is the first selection. A student then spends two years drilling in mathematics, physics, and chemistry, with a sprinkling of literature and languages. At the end of this time and after an intense preparation, he takes the concours which consists of a written and oral part. Usually a student takes part in 3-5 of those examinations. He usually fails the first time around and only makes it after having had, in effect, three years of preparation. This constitutes the second selection. Out of 1600 candidates applying to Polytechnique only 300 are chosen. Out of 4200 candidates applying for Central and three other Ecoles having the same concours, only 710 are admitted. These numbers are quite typical of the highly selective process involved. Therefore, the Ecoles end up with the cream of the crop of the incoming students. In some cases several Ecoles join together and offer the same concours. If successful, a student can enter any one of these. His choice is dictated by the kind of informal hierarchy based on prestige, snob appeal, and scientific values, i.e., on considerations which are not always justified.

About two years ago the university system was for the first time entrusted with the education of engineers on some of its campuses. In this case the entrance requirements are those of the university system, i.e., a Baccalaureat. The program consists in the preparation of a Master's thesis at the university plus a year of practical engineering in industry. In 1972 a new type of university was created in Compiègne, some 80 km north of Paris. It is called

"Université Technologique de Compiègne" and modeled after US universities. It offers diplomas in engineering in a few fields.

Also some of the Ecoles are now working in conjunction with the universities and offer more advanced Doctoral Degrees. One must add that the events of 1968 discouraged some of the bright students from enrolling in the university system. Thus in the last 10 years the Ecoles have experienced an increased popularity.

III. The Teaching in the Science and Engineering Ecoles

The Ecoles that are training engineers and scientists can be divided into four categories:

1. The General Training or Military Ecoles, which number about 20, give a general engineering background covering aspects of chemical, civil, mechanical, electrical, control, and other types of engineering together with law, economics and management. Students do not specialize in any one branch of engineering but acquire the tools and the know-how to tackle a wide range of engineering problems.
2. The Specialized Training Ecoles, which are 6 in number, cover various types of engineering. Students select an option in which they specialize.
3. The Army Application Ecoles, which number 10, train highly qualified engineers who will serve the military; some of these Ecoles also train non-military professional engineers.
4. The Specialized Ecoles, which are more numerous since they number about 100, provide advanced training in specific disciplines such as electrical, mechanical, civil, chemical and aeronautical engineering, and physics, metallurgy, food sciences, agriculture, etc. Some of these schools offer a special program labeled "Corps de..." followed by the name of the Ecole (Example: Corps de l'Ecole des Mines, Corps des Ponts et Chaussées, Corps de l'Armement, etc...) in which the top students in the graduating class of Polytechnique (and now of some of the other top Ecoles) can enter to acquire a specialization. After graduation these students work for the State in the various Ministries.

A. A General Training School: The Ecole des Mines de Nancy

This Ecole is affiliated with the "Sécretariat d'Etat Aux Universités." Its curriculum provides scientific training which is primarily of a general nature, while the technological

education is provided by periods in industry, work in the laboratory or practical exercise sessions. An important part of the Ecole timetable is devoted to non-scientific disciplines: foreign languages, economics, sociology, law, organization, methodology, etc... These represent: 30% of the teaching time in the first year, 30% in the second year, 50% in the third year. The following tables give more details on the content of the courses.

TABLE II

1st year:

All courses must be taken by all students

Physics	Mathematics	Accounting	Two foreign
Mechanics	Programing	Economics	languages
Nuclear Physics	Numerical	Organization	German
Crystallography	Analysis	of work	English
Thermodynamics	Statistics	Oral & written	Russian
		communication	

7 weeks manual work in industry

2nd year:

Common courses

Methods of	Organization	Economics	Two foreign
enquiry and	of work	Operational	languages
investigation	Functional	Research	German
	Analysis		English
			Russian

7 weeks in industry

Two of the following four options

I	II	III	IV
Solid State	Physical	Fluid	Probabilities
Physics	Metallurgy	Mechanics	Graph Theory
Metal Physics	Physico-	Heat	Computer
Metal Chemistry	Chemistry	Transfer	Science
			Mining or
			Geology

3rd year:

Common courses

Economics	Decision Making	Law	Two foreign
Marketing	Techniques	Sociology	languages:
Financial	Communication		German
Techniques	Techniques		English
			Russian

9 weeks in industry + 1 day per week
+ submission of a report

3 courses to be taken among the following

Mechanical properties of materials	Mathematical morphology
Electronic properties of materials	Methods of analysis and decision making
Metallurgy	Mining engineering
Control science	Mines and geology
Process control	Computer science
Aerothermics	Elasticity
Turbomachines	

B. A special Training School: The Conservatoire National des Arts et Métiers

The "Conservatoire National des Arts et Métiers" (CNAM) is the oldest (1794) and largest (46,000 registrations) of the French establishment specializing in adult education. The main characteristic of the CNAM is that the teaching is provided essentially by evening lectures. It is a kind of adult university with its own department of engineering which gives courses in 16 general scientific subjects, 45 technical disciplines, and 27 economics subjects. Some of the courses may be followed in one of 34 provincial centers.

The engineer's diploma may be obtained after a part-time course of a duration up to seven years, depending on the initial training of the students, or on a full-time basis in any of the 18 specialized institutes affiliated with the CNAM.

The curricula vary with the specialty chosen and include a certain amount of general non-scientific training, together with an in-depth study of a specific area. The last year is devoted to an industrial project, and the student must

submit a short thesis or a report describing his work.

C. A Specialization School: The Ecole Supérieure d'Electricité (Sup. Elec.)

The first year is common to all students and contains lectures in mathematics (70 h.), computer science (20 h.), physics (125 h.), technology (100 h.), economics (20 h.) and 2 foreign languages.

In the second year the students follow a compulsory set of lectures in economics (20 h.), management (20 h.) and foreign languages and choose one of three following specializations: data processing and instrumentation; communications systems and components; and control.

The third year is entirely devoted to a further specialization in one of the following 13 options: control science, automation, industrial electronics, fast electronics, electronic structure of materials, electrical energy, computer science, metrology and instrumentation, radio-communications, computer systems, micro-electronics, process control, and advanced computer science.

IV. Engineering in France

I conclude this report with a glance at the situation of professional engineers in France. This paragraph is especially written for the reader who thrives on statistics. For those who do not, I apologize in advance.

The annual influx of engineers is about 8700 and has experienced no appreciable variation over the last few years. Table III displays both the number of alumni and the yearly flux of engineers in a given branch of science for the years 1971-74. Another graph (Fig. 1), which is of some value, shows the distribution of engineers in the various technologies and specialties. Most of the engineers are found in the private sector as can be seen from Fig. 2, while Fig. 3 displays the functions of engineers in terms of their age. As can be seen a small percentage works in research and that percentage decreases as the engineer gets older. Finally, Fig. 4 gives an idea of the salary expressed in dollars (\$1 = 4FF) for the year 1974.

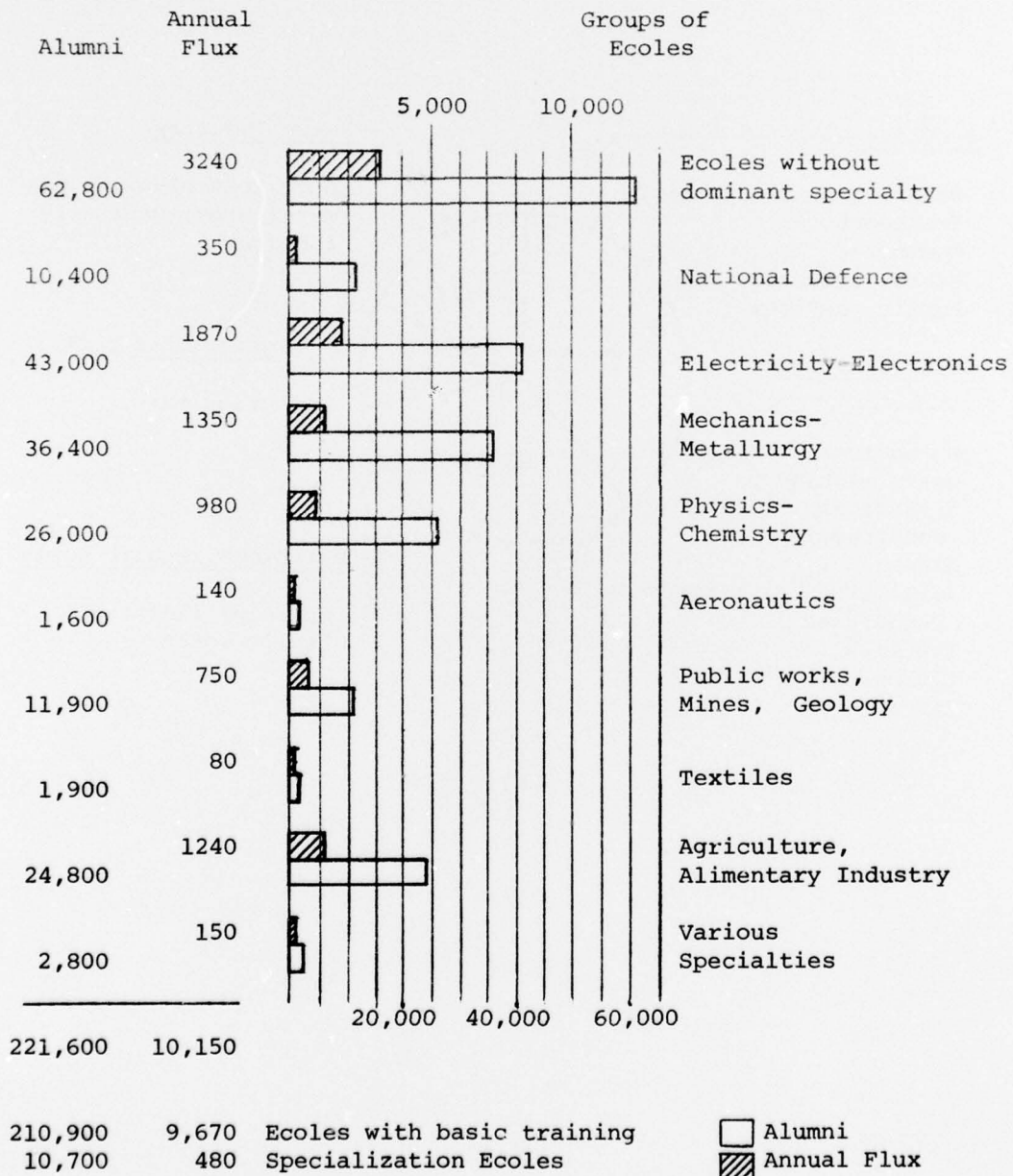
V. Conclusions

France possesses a unique higher education system

for the training of its engineers. The system is old, having been in existence for nearly two centuries. It has survived the 1968 student crisis with very minor modifications; now, students sit on some of the committees of the Grandes Ecoles. This fact ought to be an eloquent testimony for the adequacy of this system of education. These Ecoles carry out the French philosophy of "oriented research", which is not to be interpreted as applied industrial research but rather as research oriented towards a specific goal (what we might label "Applied Mathematics" in the US). I would venture to say that this system tends to form, on the whole, somewhat better engineers than the ones formed in the US although, sometimes, their lack of "practical engineering" might prove to be a drawback. Most of the Ecoles' very selective enrollment guarantees them the cream of the crop of incoming students who have acquired rigorous foundations in sciences and mathematics, a habit for work and high motivation. Some cynics claim that once accepted in a Grande Ecole, the student's toil is over and all he has to do is get out of it, and that this entails a minimum of effort.

Research in these Ecoles is supported to a high degree by industrial contracts. These contracts are also a means of keeping the teaching and research found in these institutions relevant. The graduates of these Ecoles permeate not only French industry but also the civil service and the military. These engineers have done much to provide France with the well-known French engineering know-how. The system tends to perpetuate itself via the strong ties that develop between a given Ecole and its alumni who take an active part in the running of their Ecole.

TABLE III



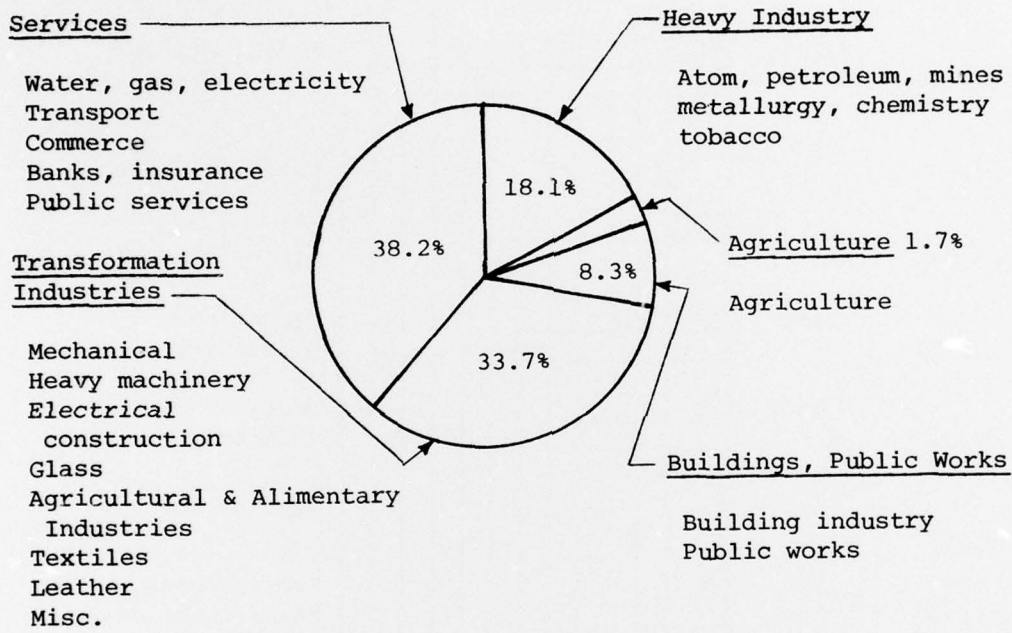
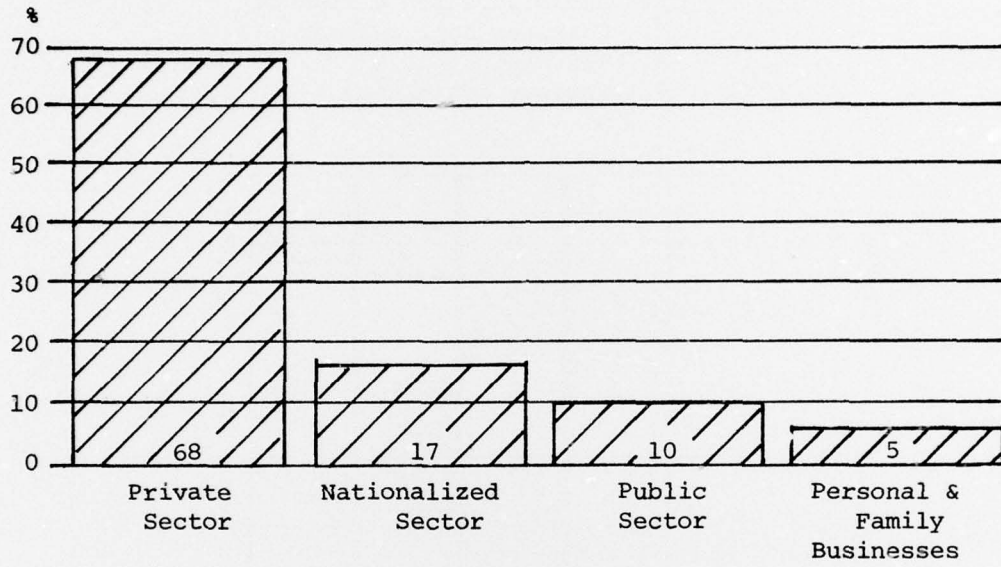


Fig. 1.



Distribution of Engineers According to the Nature of Their Company

Fig. 2.

Activities

1. Studies
2. Research
3. Technique & Fabrication
4. Technical-commercial
5. Commercial
6. Administration & Finance
7. Computer Applications
8. Teaching
9. Various Activities

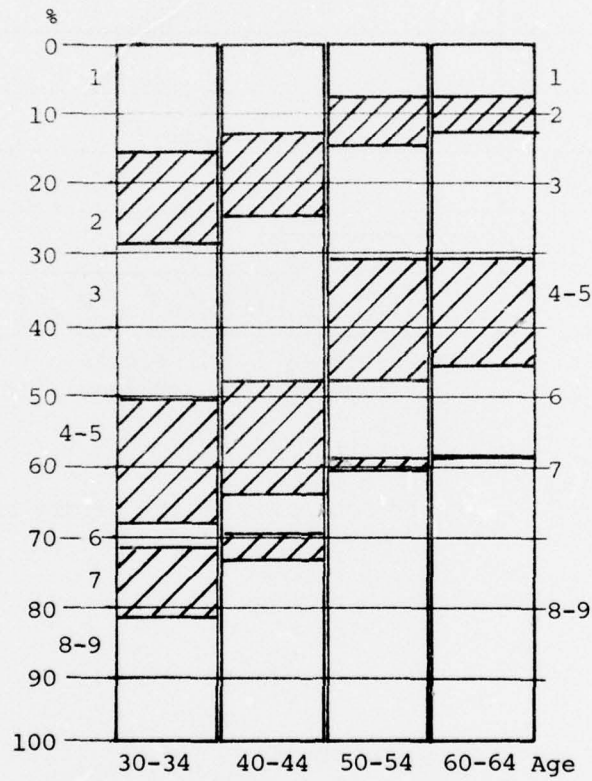


Fig. 3.

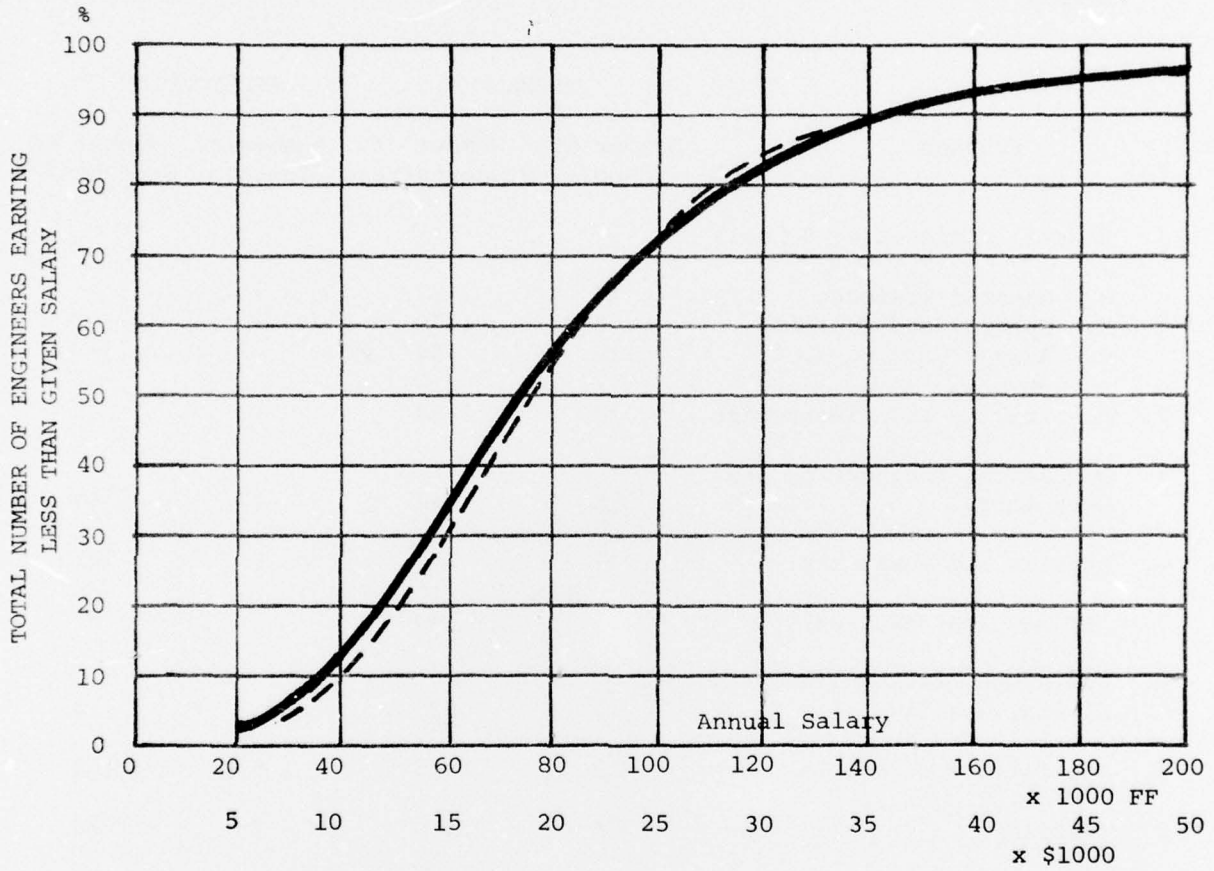


Fig. 4.

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APPENDIX

THE SCHOOLS OF ENGINEERING

SUMMARY

Subject	NORMAL		APPLICATION	
	Number of Schools	Number of Students/Year	Number of Schools	Number of Students/Yr
1. General Engineering Schools				
A. General Training	14	2187	-	-
B. Specialized Training	6	1470	-	-
C. Army	10	434	-	-
2. Electricity and Electronics	22	1853	-	-
3. Mechanical Engineering and Metallurgy	13	1434	2	40
4. Physics and Chemistry	21	890	7	291
5. Aeronautical Engineering	3	140	-	-
6. Building, Civil Engineering, Mining, Geology	7	625	1	18
7. Agriculture & Food Industry	19	1145	5	164
8. Textiles	4	100	2	28
9. Miscellaneous	<u>7</u>	<u>232</u>	<u>1</u>	<u>20</u>
TOTAL	126	10510	18	561

Abbreviations used: E. Ecole N. Nationale Sp. Spéciale
 I. Institut S. Supérieur T. Technique
 Sup. Supérieure

APPENDIX

1. General Engineering Schools (30)

A. General Training (14)

Name	Location	Founded	Students per Year
E.Centrale des Arts et Manufacture	Paris	1829	300
E.N.Sup. des Mines	Paris	1783	94
E.N.Sup. de la Métallurgie et de l'Industrie des Mines	Nancy	1918	80
E.N.Sup. des Mines	St.Etienne	1816	62
E.Sup. de Physique et Chimie Industrielle	Paris	1882	44
Ecole Polytechnique	Paris	1794	300
Ecole Polytechnique Féminine	Paris	1925	130
E.N. des Ponts et Chaussées	Paris	1747	122
E.N.Sup. des Télécommunications	Paris	1878	110
I. Industriel du Nord de la France	Lille	1854	150
E. Centrale de Lyon	Lyon	1857	165
E. d'Ingénieurs	Marseille	1891	65
I. des Sciences de l'Ingénieur	Nancy	1960	55
E.N.Sup. de l'Aéronautique et de l'Espace	Toulouse	1909	<u>110</u>
	TOTAL		2187

B. Specialized Training (6)

Conservatoire National des Arts et Métiers	Paris	1794	330
E. des Hautes Etudes Industrielles	Lille	1885	150
I. National des Sciences Appliquées	Lyon	1957	600
I. National des Sciences Appliquées	Rennes	1966	100
I. National des Sciences Appliquées	Toulouse	1963	150
E.N. des Arts et Industries	Strasbourg	1875	<u>140</u>
	TOTAL		1470

C. Army (10)

E.N.Sup. des Techniques Avancées	Paris	1765,1968	95
E.Sp. Militaire de Saint-Cyr	Coëtquidan	1802	90
Ecole Navale	Brest	1830	70
Ecole de l'Air	Salon	1933	70
Cours Supérieurs d'Engins Missiles	Paris	1958	10

APPENDIX

C. Army (10) (Cont'd)

Name	Location	Founded	Students per year
Cours Supérieurs Technique d'Armement et Artillerie	Paris	1964	15
E. Sup. T. des Transmissions	Pontoise	1956	15
E. Sup. T. du Génie	Versailles	1945	30
E.N.Sup. d'Ingénieurs des Etudes et Techniques d'Armement	Brest	1819	30
E.T.Sup. des Travaux Immobiliers et Maritimes	Paris	1960	<u>4</u>
	TOTAL		434

2. Electricity and Electronics (20)

E.Sup. d'Electricité	Paris	1894	300
E.Sup. d'Electrotechnique et d'Electronique	Paris	1904	100
E.Sup. de Mecanique et d'Electricité	Paris	1905	180
E. d'Electricité et de Mécanique Industrielle	Paris	1902	120
E. d'Electricité Industrielle	Beauvais	1901	70
E.N.Sup. d'Electronique et d'Electromécanique	Caen	1914	30
E.N.Sup. d'Electrotechnique et de Génie Physique	Grenoble	1899	100
E.N.Sup. d'Electrochimie et d'Electrométallurgie	Grenoble	1921	60
E.d'Electricité Industrielle	Marseille	1907	55
E.N.Sup. d'Electricite et de Mécanique	Nancy	1900	80
E.N.Sup. d'Electrotechnique, d'Electro- nique, d'Informatique et d'Hydraulique	Toulouse	1907	125
E.F. de Radioélectricité, d'Electro- nique et d'Informatique	Paris	1936	55
E.N. de Radiotechnique et d'Electricité Appliquée	Paris	1952	50
I.S. d'Electronique	Paris	1955	60
E.Sup. d'Electronique de l'Ouest	Angers	1956	75
E.Sup. d'Electronique et de Radio- électricité	Bordeaux	1920	40

APPENDIX

2. Electricity and Electronics (20) (Cont'd)

Name	Location	Founded	Students per year
E.N. Ingénieurs de Brest	Brest	1961	41
E.N.Sup. d'Electronique et de Radioélectricité	Grenoble	1957	80
I.S. d'Electronique du Nord	Lille	1956	80
Ecole de Radioélectricité et d'Electronique	Marseille	1956	22
I. d'Informatique d'Entreprise	Paris	1973	40
E.N.Sup. de Mathématiques Appliquées et d'Informatique	Grenoble	1899	<u>90</u>
	TOTAL		1853

3. Mechanical Engineering and Metallurgy (12 +2)

E.N.Sup. d'Arts et Métiers	Paris	1806	550
I.S. des Matériaux et de la Construction Mécanique	Paris	1948	20
Centre d'Etudes Supérieures des Techniques Industrielles	Paris	1956	40
E.N.Sup. de Chronométrie et de Micromécanique	Besançon	1927	45
E.N. d'Ingénieurs	Belfort	1962	63
I. Catholique d'Arts et Métiers	Lille	1898	66
E. Catholique d'Arts et Métiers	Lyon	1900	75
E.N. d'Ingénieurs	Metz	1962	125
E.N.Sup. de Mécanique	Nantes	1919	130
E.N.Sup. de Mécanique et d'Aérotechnique	Poitiers	1948	65
E.N. d'Ingénieurs	St.Etienne	1961	70
E.N. d'Ingénieurs	Tarbes	1963	95
E.N.Sup. d'Hydraulique	Grenoble	1899	<u>90</u>
	TOTAL		1434

"Ecoles d'Application"

E.Sup. de Fonderie	Bagneux	1923	15
E.Sup. de Soudure Autogène	Paris	1930	<u>25</u>
	TOTAL		40

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APPENDIX

4. Chemistry and Physics (21 + 7)

Names	Location	Founded	Students per year
E.Sup. d'Optique	Orsay	1920	40
E.N. Sup. de Chimie	Paris	1896	60
E.N. Sup. de Chimie	Bordeaux	1891	50
E.N. Sup. de Chimie	Clermont-Ferrand	1908	27
E.N. Sup. de Chimie	Lille	1894	50
E.Sup. de Chimie Industrielle	Lyon	1883	70
E. Francaise de Tannerie	Lyon	1899	25
E.N. Sup. de Chimie	Montpellier	1908	55
E.Sup. de Chimie	Mulhouse	1822	30
E.N. Sup. de Chimie	Rennes	1919	33
E.N. Sup. de Chimie	Strasbourg	1919	60
E.N. Sup. de Chimie	Toulouse	1907	60
E.Sup. de Chimie Organique et Minérale	Paris	1957	40
I. de Chimie	Besancon	1920	20
E.N. Sup. de Chimie	Caen	1924	15
I. de Chimie et Physique Industrielles	Lyon	1919	50
E. Sup. de Physique	Marseille	1961	20
E. Sup. de Chimie	Marseille	1917	30
E.N. Sup. des Industries Chimiques	Nancy	1887	55
I.N. Sup. de Chimie Industrielle	Rouen	1918	60
I. de Génie Chimique	Toulouse	1949	<u>40</u>

TOTAL 890

"Ecoles d'Application"

I.N. des Sciences et Techniques Nucléaires	Paris	1956	70
E.N. Sup. du Pétrole et des Moteurs	Paris	1925	147
E. Sup. d'Application des Corps Gras	Paris	1952	8
E.T. Sup. du Laboratoire	Paris	1945	25
E. d'Enseignement T. de l'I. Français du Caoutchouc	Paris	1942	12
I. de Pétroléochimie et de Synthèse Organique	Marseille	1959	13
E. d'Application des Hauts Polymères	Strasbourg	1965	<u>16</u>

TOTAL 291

APPENDIX

5. Aeronautical Engineering (3)

Name	Location	Founded	Students per year
E. Sp. des Travaux Aéronautiques	Paris	1930	22
E.N. de l'Aviation Civile	Toulouse	1948	68
E.N. d'Ingénieurs de Constructions Aéronautiques	Toulouse	1948	<u>50</u>
	TOTAL		140

6. Building, Civil Engineering, Mining, Geology (7 + 1)

E. Sp. des Travaux Publics du Batiment et de l'Industrie	Paris	1891	294
E. des Ingénieurs des Travaux Publics de l'Etat	Paris	1953	150
E. des Ingénieurs de la Préfecture	Paris	1959	40
E.N.T. des Mines	Alès	1843	40
E.N.T. des Mines	Douai	1878	33
E.N. Sup de Géologie Appliquée et de Prespection Minière	Nancy	1908	38
Institut de Physique du Globe	Strasbourg	1919	<u>12</u>
	TOTAL		625

"Ecole d'Application"

I.S. du Béton Armé	Marseille	1952	<u>18</u>
	TOTAL		18

7. Agriculture and Food Industry (18 +5)

I. National Agronomique	Paris	1826	175
E.N. Sup. Agronomique	Montpellier	1872	70
E.N. Sup. d'Agronomie et des Industries Alimentaires	Nancy	1893	95
E.N. Sup. Agronomique	Rennes	1826	70
E.N. Sup. Agronomique	Toulouse	1911	55
E.N. Sup. des Industries Agricoles et Alimentaires	Paris	1893	55

APPENDIX

7. Agriculture and Food Industry (Cont'd)

Name	Location	Founded	Students per year
E.S. d'Ingénieurs et Techniciens pour l'Agriculture	Paris	1919	40
E.N.S. d'Horticulture	Versailles	1873	40
E.S. d'Agriculture	Angers	1898	55
I. Agricole	Beauvais	1854	55
E.N. d'Ingénieurs des Travaux Agricoles	Bordeaux	1962	65
E.N. d'Ingénieurs des Travaux Agricoles	Dijon	1967	60
I. de Biologie Appliquée à la Nutrition et à l'Alimentation	Dijon	1964	20
I.S. d'Agriculture	Lille	1963	40
E.N. des Ingénieurs des Travaux des Eaux et Forêts	Nogent sur Vernisson	1884	30
E.N. Sup. Féminine d'Agriculture	Rennes	1964	30
E.N. des Ingénieurs des Travaux Ruraux et Techniques Sanitaires	Strasbourg	1960	50
E. Sup. d'Agriculture de Purpan	Toulouse	1919	70
I.N. de Promotion Sup. Agricole	Dijon	1973	50
	TOTAL		1145

"Ecoles d'Application"

E.N. du Génie Rural des Eaux et Forêts	Paris	1824	70
E. Française de Meunerie	Paris	1924	4
I. d'Etudes Supérieures d'Industrie et d'Economie Laitière	Paris	1963	5
E. Sup. d'Agronomie Tropicale	Nogent sur Marne	1902	35
E.N. Sup. des Sciences Agronomiques Appliquées	Dijon	1966	50
	TOTAL		164

APPENDIX

8. Textiles (4 + 2)

Name	Location	Founded	Students per year
E.S. de Filature et de Tissage de l'Est	Epinal	1905	15
E.S. des Industries Textiles	Mulhouse	1861	25
E.N.S. des Arts et Industries Textiles	Roubaix	1885	25
I.T. Roubaisien	Roubaix	1895	<u>35</u>
	TOTAL		100

"Ecoles d'Application"

I. Textile de France	Paris	1948	8
E. Sup. des Industries du Vêtement	Paris	1945	<u>20</u>
	TOTAL		28

9. Miscellaneous (6 + 1)

E.N. Sup. de Céramique Industrielle de Sèvres	Paris	1893	20
E. Sup. du Bois	Paris	1934	30
E.N. des Sciences Géographiques	Paris	1941	12
E. Sup. des Géomètres et Topographes	Paris	1945	30
E.N. de Météorologie	Paris	1948	10
E.F. de Papeterie	Grenoble	1907	30
E.N. de la Santé Publique	Rennes	1973	<u>100</u>
	TOTAL		232

"Ecoles d'Application"

I. Français du Froid Industriel	Paris	1942	<u>20</u>
	TOTAL		20