

EUROPEAN REGION

HIGHER EDUCATION IN FRANCE AND THE INTERNATIONAL MIGRATION OF SCIENTISTS

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THE FRENCH SYSTEM OF HIGHER EDUCATION

THE CURRENT SITUATION: A FRENCH ORIGINAL

One of the major reasons for the complexity of the French system lies in the dichotomy, unique in Europe, between its universities and the elite *Grandes Ecoles*. This coexistence of two different types of institutions arises from historical circumstances. In the 18th century, the political establishment, which was wary of the Church's power over the university, founded the *Grandes Ecoles* to train the ranks of military and technical personnel needed by the state. In the past, preference was given to one or another of these institutions, depending on the political climate of the country. During the 20th century, however, the increasing importance of technology has slowly but surely turned the *Grandes Ecoles* into the sole route to the highest positions in French government. Institutions designated as *Grandes Ecoles* or simply *Ecoles* have proliferated, especially in the fields of economy and business.

Between 1960 and 1997, the number of students enrolled in higher education rose from 310,000 to 2.1 million. The students are distributed between the *Ecoles* (238 engineering schools, 230 business schools), which select 9.5 percent of the students in higher education; the general university system, which educates 62 percent of the total; technical and technological higher education institutions (*Instituts Universitaires de Technologie, écoles universitaires d'ingénieurs*), which account for 16 percent; and paramedical and social training, which make up the remainder. Both the universities and the *Grandes Ecoles* (with the exception of business schools) are a part of the national public system and free for students.

The Universities. University education is divided into three cycles.

1. The first cycle (equivalent to freshman and sophomore years of college) leads to the *Diplôme d'Enseignement Universitaire Général* (General University Diploma) in 2 years.
2. The second cycle leads to the *licence*, equivalent to a bachelor or arts degree and 1 year of study toward a master's degree.
3. The third cycle leads to a higher level professional degree (*Diplôme d'Etudes Supérieures Spécialisées* in 1 year) or a doctoral degree.

The *Grandes Ecoles*. One of the great advantages of the *Grandes Ecoles* in engineering and business is the quality of their student population. Most of these schools pick their students through competitions, primarily among candidates from *Grandes Ecoles* preparatory classes. This educational track, over 2 or 3 years, attracts the best students from the best high schools. The *Ecoles* offer better conditions, with smaller class sizes and better equipment and facilities (computers, classrooms, laboratories) than most universities. The cost to the government is significantly higher: \$12,500 per student per year, as opposed to \$5,900 in the standard first cycle.

Finally, the graduates of the *Ecoles* are able to find professional employment much more easily than their contemporaries from the university system, due to an education aimed at a particular goal, the contacts they made with the business world during their educational career, and their alumni networks.

A SYSTEM IN CRISIS

At the University. A large number of students fail during the first, general, cycle: 34 percent drop out in the first year, and only 28 percent successfully complete the 2 years. In addition, the degree awarded does not lead to any particular professional position.

The quality of instruction in the universities suffers in part due to the system used to evaluate the professors, which looks at research and scholarly publications. A diploma does not necessarily make employment easier to find, since public service is no longer the major outlet for graduates, and the private sector does not value the degrees. The business world and the needs of the high-technology sector of the economy are, in their turn, not well understood by the universities.

University research suffers also from a lack of means, coordination, and links to the private sector. The university administration is inefficient and does not have enough autonomy. It cannot recruit the technical personnel it needs. The different faculties and the engineering schools within the universities guard their independence jealously.

Unlike the *Grandes Ecoles*, which can be selective, the universities are required to accept all candidates. In practice, legal (e.g., limited space in the medical schools) or illegal means of selection control recruitment. University diplomas, which are theoretically all supposed to have the same value and which are awarded by the state without reference to a particular university site, are, in fact, ranked on the job market according to campus.

In the *Grandes Ecoles*. The percentage of students in the engineering *Grandes Ecoles* went from 14 percent of total engineering enrollment in 1900 to 3.7 percent in 1997. Selection has become more and more rigorous, and the student population more and more unbalanced. Most of the students are from the families of government officials and corporate executives. The majority of those participating in the competitions for the most elite schools (*Ecole Normale Supérieure*, *Ecole Polytechnique*) come from only about 10 high schools.

The mostly theoretical instruction provided does not always leave enough time for less theoretical work, for innovation, or for work on specific projects. Ideas necessary to the vitality of business, like intellectual property rights and human rights, are not always addressed in sufficient detail. Students are not always trained in scientific research and its methods. Finally, there is insufficient external evaluation of the education and the degrees.

Counseling at the universities is scarce, so the students depend primarily on other information sources when making choices. In the *Grandes Ecoles*, those choices

are most often guided by the reputation, rather than by the content, of the studies. The nature of the two styles of instruction is converging as the universities become more industry-oriented. With the disappearance of its *raison d'être*, the difference between the two is gradually becoming less apparent.

PROPOSED REFORMS: REORGANIZING THE FRENCH EDUCATIONAL SYSTEM FOR THE 21ST CENTURY

In this period of increased economic competition, market forces sweeping the professional world cannot ignore higher education. But the logic of the marketplace, already at work in some countries, brings with it monetary discrimination and a growing gap between a few elite institutions where quality comes with a very high price tag, and a large, more or less mediocre, system for the vast majority of students. In France, this trend in higher education would eliminate equal access to education, one of the foundations of the republic.

The French system of higher education has been in existence for almost 1,000 years. As in almost every other country in the world, it is faced with three major challenges: the growth of its bureaucracy, the diversification of knowledge and skills needed, and the increasing costs of education.

With most European countries confronting these questions, this is a particularly propitious time to inaugurate reforms. A commission appointed by Prime Minister Lionel Jospin has just released a report on the subject.¹ This paper summarizes the report's principal conclusions.

Redefining the Missions of Higher Education. Higher education should allow each student to identify his or her individual strengths and to pursue studies in different disciplines by increasing contacts and connections between the different university departments.

Currently, researchers in public institutes such as the National Institute of Health and Medical Research (INSERM) and the National Committee for Scientific Research (CNRS) are not required to teach; university professors conducting research have been able to spend much of their time in their laboratories, since it has always been the quality of their research that is used to

¹"Toward a European Model of Higher Education," report of the commission presided over by Jacques Attali, STOCK, May 1998.

evaluate them. All publicly funded researchers, in both the institutes and the universities, must be required to spend more time in the classroom.

Education should combine formal training for business and technology with the transmission of cultural appreciation (literature, philosophy, humanities) and general knowledge. It should encourage the faculty to strive for innovation.

Continuing education must take its place in the system of higher education. It must award diplomas with the same value as those of regular university degrees by allowing students to alternate between periods of work and study. It must allow the unemployed to receive training that is useful in the job market.

The system should also provide means for students from more modest backgrounds, who tend to pursue studies that are technically oriented, to switch to educational tracks that are more academically and intellectually inclined by creating more bridges between the two tracks.

Another goal would be to emphasize a global perspective and encourage integration with the European Community's educational system. This might be achieved by offering all students in higher education a term of study abroad and by accepting the best foreign students and instructors into the French school system. It would require improving recruitment, using English for some subjects, easing the bureaucratic procedures for recognizing diplomas from other countries, harmonizing the curricula with those of the other countries of the European Union, and—finally—adopting the European Union's evaluation criteria and procedures.

New Principles of Organization—National Level. France's system of higher education needs to become more coherent in setting curricula, levels of degrees, and geographic distribution of its campuses. Campuses must be located near the emerging centers of excellence, the *Pôles Universitaires Provinciaux* consisting of the best university and *Grandes Ecoles* departments in a region (including the campuses of neighboring countries) linked in networks. These "university centers" will have a common teaching and research orientation.

Each university center will need to establish more regular contractual relationships with the state, allowing the center more autonomy. These relationships will be

based on a campus plan and quadrennial contracts, which will allow the universities more initiative in defining their academic offerings.

As a reasonable balance to this increased autonomy, a regular evaluation of the strengths and performance of each campus or university department will influence its financing. To this end, the creation of a new *Agence Supérieure d'Evaluation* has been proposed, which would be outside the authority of the Ministry of National Education. Academic evaluation would be conducted by peers.

Evaluation of professors would take teaching abilities into account. It would initiate a system of student evaluations and incorporate them into reviews of the instructors. The professors would have to be able to relocate, and there would be greater possibilities for mobility in posts. A pay scale that would be more responsive to merit while providing better salaries would accompany these new requirements.

New Principles of Organization—Local Level. As in an urban community, these campuses of higher education must organize themselves under a single administration, sharing materiel and human resources, creating a comprehensive curriculum, and encouraging exchanges between establishments. Entrepreneurial enterprises must be encouraged on these campuses through the availability of capital risk funding, especially in the fields of software engineering, biotechnology, and materials. Career advancement and continued education via alumni associations must be expanded to include the entire campus.

Reforming the Curricula. The curricula must be reworked to facilitate transfers between the universities and the *Ecoles*, and the degrees must be more equivalent to those awarded in other countries. The primary objective would be to make all new diplomas have a recognized value in the job market and lead to real careers.

In the universities, university education would be divided into:

- A *licence* in 3 years, consisting of individually accumulated credits, allowing each student to mix studies and work. The first semester would be aimed at choosing a major; the last year, including a term of work-study, would have a general professional orientation. Class sizes would be re-

duced by using secondary school instructors. Technological education would follow the same schedule.

- A new *maîtrise* in 2 years after the *licence* would serve to further a particular major course of study. The second year would be dedicated to an individual research program or to subjects that would complement the major field.
- A doctoral program 5 years after the *licence*, called *Ecoles Doctorales*, would offer the option of taking the *maîtrise* exams after 2 years. It would include multidisciplinary studies, career counseling, and more interaction with industry. Research would start earlier in the curriculum than is currently the case.

The first 3 years of medical studies would be grouped with biological sciences, resulting in a new biomedical *licence*. Limitation in the number of enrollments would not commence until after the *licence*. A doctorate in medicine would take the same amount of time as in other disciplines and would be open to students from other scientific fields.

This plan, called “3-5-8,” is more or less parallel to the American system of higher education given the fact that, in France, high school lasts 1 year longer than in the United States.

In the *Grandes Ecoles*:

- Preparatory classes would be phased out once the changes had been made in the first university cycle. The entrance exams would change so as to open enrollment in the *Ecoles* to students following technology tracks.
- While remaining an elite track for technical training, the *Grandes Ecoles* would grant the *licence* at the end of the first year, and the new *maîtrise* at graduation.
- The monopoly held by the *Grandes Ecoles* in filling government posts will be ended.

CONCLUSION

Financing all these reforms, especially the lengthening of the first university cycle, will require a significant national effort. But demographics indicate that the population entering the universities will be falling, and the proposed regrouping will realize savings as well. Fiscal and regulatory measures should encourage business and regional governments to join in this effort.

Without requiring uniformity of systems, the countries of Europe should standardize their curricula and diplomas within a new framework that is neither bureaucratic nor strictly independent. The European Union still needs to define a policy for higher education; this could be one of its major tasks in the next decade.

DOCTORATE AND POSTDOCTORATE

FOCUS ON THE FRENCH DOCTORATE

France, with its long tradition of higher education, produces a considerable number of Ph.D.s. In fact, it produces a higher percentage of doctors per million inhabitants than any other industrialized country.

Table 1. Ph.D. theses per million inhabitants

Country	Number of theses	Population (millions)	Theses per million inhabitants
Australia.....	(1993) 1,803	17.7	102
Canada.....	(1993) 3,356	29.0	116
Denmark.....	(1992) 512	5.2	98
France.....	(1995) 9,800	58.5	168
Germany.....	(1993) 12,400	81.0	153
Great Britain....	(1994) 8,300	58.0	143
India.....	(1987) 4,177	(est.) 700.0	6
Italy.....	(1998) 2,400	57.0	42
Japan.....	(1993) 12,000	124.5	96
Mexico.....	(1990) 269	86.2	3
United States....	(1994) 41,011	260.0	158

SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

Given that France ranks fourth in research and development (R&D) budget, after the United States, Japan, and Germany, and fifth in the publications world share after the United States, the United Kingdom, Japan, and Germany, its influence in science education is remarkable. Its success is also due to a conscious national effort over the past 10 years to improve and expand its higher education establishment.

Between 1989 and 1997, the number of Ph.D.s awarded doubled from 6,000 to 12,000. The following table shows this growth through the year 1996. All disciplines demonstrated this strong growth. The social sciences and humanities represent almost one-fourth of the Ph.D.s awarded. Physics and chemistry and the life sciences were also popular.

The proportion of women receiving Ph.D.s reached 36.8 percent (42.3 percent of French and 25.4 percent of foreign recipients) in 1996. These numbers increase steadily but vary greatly from one scientific discipline to another. In the life sciences, more than half of the Ph.D. recipients are women. The percentage is also high in the social sciences, law, and physics and chemistry. The lowest percentages are observed in mathematics, computer sciences, and engineering.

Funding for graduate studies has traditionally come from the Ministry for Education, Research and Technology. It allocates grants for 3 years, allowing the student to complete the research for a thesis. This program was begun in order to shorten the number of years spent on preparing a thesis, which could take as many as 7 to 10 years. This 3-year period does not include the 2 years of the third cycle after the French *maîtrise*, which is devoted to classes.

The doubling of the number of degrees has had a great deal to do with the difficulty facing students who graduate with a *maîtrise* when they start looking for employment. The unemployment situation has had an impact too on the type of funding available. Since 1996, ministry scholarships have been granted to no more than 28 percent of all students. Foundations and corporations fund more than one-third of the total. Nearly 1 in 10 Ph.D. students have to support themselves by working. A full 28 percent of the graduate students have no scholarships or reported income whatsoever. This is a source of great concern.

It is important, nonetheless, to emphasize that this situation varies greatly from discipline to discipline. More than half of the students in the social sciences and hu-

Table 2. Ph.D.s awarded from 1989-96

Disciplines	1989	1990	1991	1992	1993	1994	1995	1996
Total.....	5,963	6,782	7,198	8,585	9,295	10,602	9,801	10,963
Mathematics.....	198	233	247	296	356	418	364	426
Physics and chemistry.....	1,378	1,466	1,537	1,897	1,940	2,168	1,943	2,148
Geosciences.....	328	335	313	418	410	439	453	499
Computer and information sciences.....	810	868	903	1,029	1,085	1,176	1,237	1,342
Life sciences.....	1,223	1,436	1,409	1,664	1,843	1,972	1,882	1,999
Social sciences and humanities.....	1,017	1,256	1,425	1,746	2,006	2,540	2,197	2,414
Law.....	545	621	706	832	908	1,071	906	1,139
Engineering.....	464	567	658	703	747	818	819	996

SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

Table 3. Percentage of women who received Ph.D.s, 1992-96

Disciplines	1992	1993	1994	1995	1996
Total.....	31.9	33.1	35.1	34.9	36.8
Mathematics.....	17.5	18.7	16.5	20.5	20.9
Physics and chemistry.....	31.0	32.8	34.2	34.5	39.5
Geosciences.....	24.6	28.0	37.8	34.5	32.1
Computer and information sciences.....	17.6	16.1	20.3	20.1	19.9
Life sciences.....	45.9	47.2	51.8	51.0	50.7
Social sciences and humanities.....	41.2	43.6	42.7	41.2	44.7
Law.....	31.2	32.0	33.1	30.4	36.0
Engineering.....	14.8	14.6	13.7	16.6	18.3

SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

manities have no funding or insufficient resources. By contrast, around 90 percent of the students in physics and chemistry, computer sciences, life sciences, and engineering are fully funded.

Of positions overseas, 46.3 percent are in North America. It is the most favored destination for those in the life sciences and engineering. The European Union (other than France) is now in second place, after North America,

Table 4. Origin of funding for Ph.D.s awarded in 1996

Disciplines	Scholarships from the MENRT	Scholarships from other sources	Salaries	No funding	Total
Total.....	2,936	3,521	964	2,919	10,340
Mathematics.....	141	137	27	116	421
Physics and chemistry.....	755	999	80	216	2,050
Geosciences.....	227	183	15	39	464
Computer and information sciences.....	478	617	77	117	1,289
Life sciences.....	684	711	213	340	1,948
Social sciences and humanities.....	181	197	377	1,363	2,118
Law.....	197	164	126	595	1,082
Engineering.....	273	513	49	133	968

SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

THE POSTDOCTORATE

The postdoctoral position was not common in France before the 1970s. Most scientists found employment in the university or in the public research institutes. Ph.D.s led, almost automatically, to permanent government positions. Today, tight budgets and increased numbers of graduates have moved the threshold at which scientists can find such employment to a more advanced stage of their careers. In addition, the internationalization of science has made a postdoctorate in another country highly desirable. There is also almost no financing available in France for French postdoctorates. Therefore, more and more French Ph.D.s are having to seek postdoctoral positions abroad.

Until now, it has been impossible to deal with this situation in France with any kind of concerted national effort, since the status of postdoctorate implies a lack of permanence. French law and French unions are opposed to the permanent creation of temporary positions for French citizens. Foreigners, however, are not covered by these limitations.

An estimated 1,900 or more Ph.D.s actually took postdoctoral positions after defending their theses in 1996. As in the 3 preceding years, two-thirds of the postdoctoral positions are located abroad. The exact proportion is 66.7 percent. Only 350 French Ph.D.s pursued postdoctoral terms in France, compared to 400 the previous year.

North America (the United States and Canada) is still the preferred destination for postdoctorates this year.

with 41.3 percent of positions abroad, compared to 40.2 percent in 1995. More than one young Ph.D. in two in physics and chemistry opts for a position in a European Union country. Japan attracts only 3.2 percent of the postdoctorates going abroad. All other countries combined attract 7.8 percent.

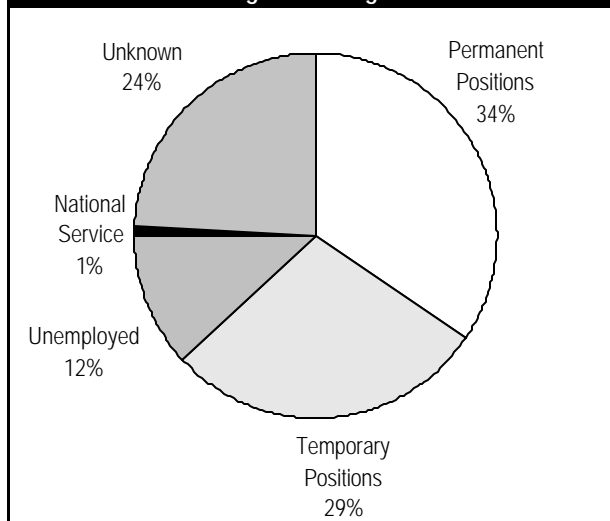
A postdoctorate in France lasts at least 2 years. More than one in eight postdoctorates will eventually stay in the country offering the postdoctoral position: 103 postdoctorates (73 French and 30 other nationalities).

EMPLOYMENT FOR SCIENTISTS

Two years after getting their degrees in 1996, 34 percent of Ph.D. recipients have found permanent employment. Another 29 percent have found temporary positions, and 12 percent are still unemployed. The remaining 24 percent did not respond to a request for information. This, of course, renders extensive interpretation dubious. The general tendencies shown by the responses, however, confirm the experienced judgment of researchers in the field.

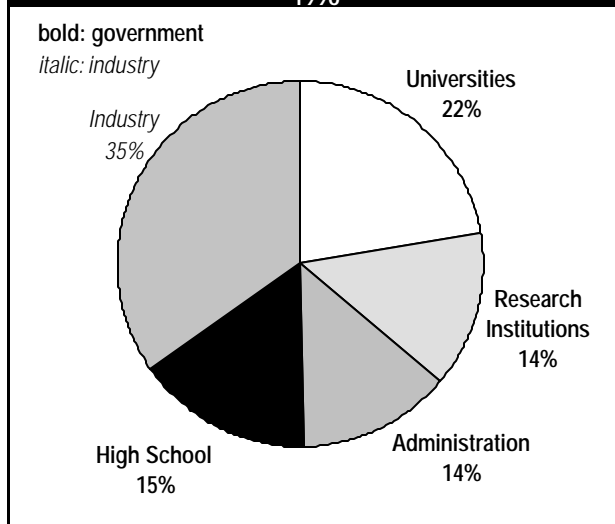
Of the permanent positions offered to the 3,559 Ph.D.s, 65 percent are with the French government: 22 percent work as assistant professors, 14 percent serve as research scientists in public institutions, 15 percent teach in high schools, and 14 percent work in the administration. Only 1,246 found jobs in industry.

Figure 1. Professional positions held by the 10,340 Ph.D.s who got their degrees in 1996



SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

Figure 2. Permanent positions held by 3,559 Ph.D.s in 1996



SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

This means that out of more than 10,000 Ph.D.s per year, only 12 percent find jobs in industry, and less than one-fourth were able to follow the traditional path of French doctoral recipients by finding permanent government positions. The number of positions in industry is an estimate based on survey responses and confirms the perception in France that industry does not recruit a sig-

nificant percentage of Ph.D. recipients. In France, the largest employment sector is small business. However, high-tech small businesses are scarce, and the large industrial firms are still recruiting the majority of their professional workforce directly after graduation from the *Grandes Ecoles*. This situation is one of the reasons young French scientists come to the United States (see last section of this paper).

FOREIGN STUDENTS IN FRANCE

GENERAL

France has always been one of the favorite destinations of immigrants from the rest of Europe, from Africa, and more recently from Asia. Immigrants come to France when migrating to the West, and also when migrating from the former French colonies. The French educational system is one of the major attractions. In 1996-97, there were 1,449,129 students in French universities, of which 125,205 (8.6 percent) were foreigners. For the past 10 years, this percentage has declined slightly. In 1985-86, 13.6 percent of the entire student population came from other countries.

Half of the foreign student population comes from Africa; they are evenly distributed among all the sciences and humanities. Twenty-nine percent come from other European countries, and show a marked preference for the humanities and social sciences. Just 2,774 students (2 percent) come from the United States to study in France. Nearly all of them take liberal arts and social sciences. Only 100 pursue courses in science and engineering (S&E).

DOCTORAL STUDENTS

The distribution of students by region of origin at the doctoral level shows approximately the same proportion as that of all foreign students in French universities.

That same year (1996-97), there were 2,807 doctoral degrees awarded to foreign students, representing 27.1 percent of all doctorates awarded that year. The proportion of foreign degree recipients was 1.2 percent

Table 5. Foreign students in French universities 1985-96

Foreign Students	1985	1989	1991	1992	1993	1994	1995	1996
Number of foreign students in thousands...	132	132	137	138	140	134	130	125
% of foreign students.....	13.6	11.8	11.2	10.7	10	9.4	8.9	8.6

SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

Table 6. Foreign students in French universities 1996-97 (by region and discipline)

Region	Law	Economics	Liberal arts and social science	Science and engineering	Medicine, pharmacy, and dentistry	Total
Total.....	15,418	16,368	47,033	27,811	18,575	125,205
% foreigners.....	8.2	10.7	9.1	5.5	12.6	8.6
Europe.....	5,557	3,905	17,563	6,055	2,736	35,816
European Union.....	4,394	2,823	13,627	4,443	1,657	26,944
Asia.....	1,358	1,512	6,451	3,761	3,249	16,331
Africa.....	7,485	10,392	16,560	16,616	11,937	62,990
Americas.....	989	527	5,333	1,290	609	8,748
United States.....	353	59	2,225	104	33	2,774
Brazil.....	93	71	687	274	94	1,219
Canada.....	126	67	600	152	56	1,001
Oceania.....	7	10	95	23	5	140
Stateless.....	22	22	1,031	66	39	1,180

SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

Table 7. Foreign candidates receiving the French doctorate in 1996

Country of origin	Number	Percent
Asia.....	276	9.8
Eastern Europe.....	136	4.8
Europe.....	365	13.0
Latin America.....	261	9.3
Near & Middle East.....	240	8.6
North Africa.....	1,015	36.2
North America.....	53	1.9
Sub-Saharan Africa.....	399	14.2
Other.....	62	2.2

SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

lower than in 1995, although the proportion of Europeans remained the same at 18.4 percent. All scientific disciplines were affected by this slight reduction. At this level

too, more than half of the degree recipients in 1996 came from Africa. Even now, Europeans tend to pursue doctorates in their own countries. Nearly 10 percent come from Latin America. This relatively high number reflects the fact that France is a traditional refuge for immigrants seeking political asylum from these countries. Latin Americans prefer France as an alternative to the United States and Spain.

Mathematics attracts the highest percentage of foreign students pursuing doctorates, although the highest number of students is found in the humanities and social sciences. Physics and chemistry attract the next highest number.

The rate at which foreign students return to their countries of origin has dropped slightly; half of them do go home in the 18-month period following their thesis defense.

Table 8. Distribution and rate of return of French Ph.D.s of foreign origin (1997)

Disciplines	Number of foreign doctors	Percentage of all doctors	Number of returns to country of origin	Percentage of returns to country of origin
Total.....	2,807	27.1	992	35.3
Mathematics.....	161	38.2	42	26.1
Physics and chemistry.....	500	24.4	196	39.2
Geosciences.....	149	32.1	52	34.9
Computer and information sciences.....	366	28.4	91	24.9
Life sciences.....	345	17.7	125	36.2
Social sciences and humanities.....	633	29.9	244	38.5
Law.....	343	31.7	121	35.3
Engineering.....	310	32.0	121	39.0

SOURCE: French Ministry for National Education, Research and Technology (MENRT), 1997.

POSTDOCTORATES

Postdoctoral positions have not been the norm in France; scientists have always been employed by the government in the past, and the temporary nature of postdoctoral positions has been alien to employment policy. The Anglo-Saxon experience with the benefits of postdoctoral work in a different scientific environment has, however, won over the French scientific community. Funding programs and positions have not yet been established enabling French labs to hire French nationals in large numbers as postdoctorates. Funding does exist for them to hire foreign nationals. Every year, about 500 new foreign postdoctorates find employment in French labs.

The proportion of foreigners at the postdoctoral level has greatly decreased. In 1995, this group still accounted for 38 percent; in 1996, it was down to only 22 percent foreigners. The percentage of postdoctorates returning to their own countries is between 35 and 50 percent by the end of 2 years.

YOUNG FRENCH SCIENTISTS IN THE UNITED STATES²

Each year, American universities receive 450,000 foreign students. This number, which might seem high, actually represents no more than 3 percent of the total population of students in the United States in all years of study. For comparison, about 9 percent of the students in the French university system come from other countries.

Despite this disparity in percentages, the United States, which is the world leader in R&D, has a reputation for being very attractive for students and scientists worldwide. It is only through more detailed analysis that it is apparent that the number of foreign students in the United States is especially high in science and engineering. That percentage increases with grade level. Almost half of the foreign students in the United States are in S&E. While only 3.7 percent of the bachelor's degrees (the American equivalent of the *licence*) awarded in S&E go to foreign students, that percentage climbs to 24 percent at the master's degree level (*troisième cycle*), and reaches 39 percent among doctorate-holders.

France only ranks 16th in terms of the number of its citizens enrolled as students in American universities. Among the 8,000 doctorates in S&E awarded each year to foreign students in the United States, only about 100 go to French citizens. This means that there are no more than 500 French citizens currently pursuing their doctorates in American universities.

The attraction of American R&D, however, is not limited to university studies. Many doctors come here for postdoctoral positions (postdoctorates) in American laboratories. Among scientists from countries like France, which has an excellent system of public education, it is much more common to seek experience in the United States at the postdoctoral stage than during the university career. The problems encountered in the past few years by young doctorate-holders when they seek to enter the French workforce have only served to exaggerate this tendency. The data presented in this report confirm that today there are *at least twice as many postdoctorates as doctoral candidates in the population of French citizens who are identified as being involved in science and engineering and are currently in the United States.*

These young scientists, who demonstrated their intellectual excellence during their university careers, and who often sought a postdoctorate appointment in the United States as something that would enhance their chances of one day finding employment as staff in a French university or public institution, represent the population commonly defined when speaking of a "brain drain." A closer look at the situations of these French postdoctorates in the United States and at their aspirations shows that they tend more toward being temporarily overseas, with plans to return eventually to France, than permanent expatriates.

This section looks at the physical presence of French scientists and engineers in the United States using data obtained from the National Science Foundation (NSF) and other American institutions. It is supplemented with the results of a survey of French doctoral candidates and postdoctorates in North America conducted by the CNRS Washington office.

²This section is based on American data and is excerpted from Damien Terouanne, *French Presence in the United States in Science and Technology* (Arlington, VA: National Science Foundation, forthcoming).

The data available from American government agencies and other institutions made it possible to study separately four populations that constitute the French presence in the United States:

- people born in France, having a college or graduate degree in science or engineering obtained either in the United States, France, or elsewhere, who are counted as permanent residents of the United States;
- scientists and engineers moving to the United States each year for professional or other reasons;
- French students enrolled in American universities; and
- French students pursuing a Ph.D. in an American university.

That last population is a subgroup of the third category, but since the data about the two groups were of both different origin and nature, a separate presentation was deemed preferable.

FRENCH CITIZENS WITH BACHELOR'S OR GRADUATE DEGREES LIVING IN THE UNITED STATES

The data presented in this section came from NSF's SESTAT Integrated File database, which contains the results of three surveys conducted among people with college or graduate degrees *living as permanent residents* in the United States. The data used for this current study concern persons born in France, less than 76 years old, with a bachelor's or graduate degree obtained either in this country or elsewhere, living in the United States at the time of the 1990 census.

Throughout this part of the study, therefore, we are looking not at the movement of a group of people, but at a permanent population of French citizens living in the United States having a college or graduate degree. The first findings look at all degrees—S&E as well as all other majors. The figures on those with S&E degrees are then studied in greater detail.

Four levels of degrees are considered: the bachelor's (baccalaureate +3 in France); the master's (baccalaure-

ate +5 or 6); the Ph.D. (doctorate); and professional degrees (law degree, medical degree, etc.). Only the first three degrees apply when analyzing the S&E population.

The fields comprising S&E are:

- the physical sciences;
- the life sciences, including the Ph.D. in medicine;
- the social sciences, including psychology;
- mathematics and computer science; and
- engineering.

General Findings. In 1990, the United States census counted 31,400 permanent residents born in France with college or graduate degrees. Of those surveyed, 71.3 percent had obtained their highest degree in the United States, 23.7 percent had obtained it in France, and 5 percent received their highest degree in other countries.

Among those surveyed, 57.9 percent studied or graduated from high school in the United States, with 35.5 percent having completed secondary school in France, and 7 percent in other countries. Of that population, there were 8,960 with degrees in S&E, 28.6 percent of the total.

There were 2,810 French citizens with a doctorate from an American, French, or other institution who were counted as being permanent residents of the United States in 1990. The origin of their doctoral degrees is as follows:

- 920 French doctorates—33 percent,
- 1,830 American doctorates—65 percent, and
- 60 from a third country—2 percent.

Persons With Degrees in S&E: Country in Which They Received Their Secondary and Higher Education. Of those 8,960 French citizens surveyed in the United States in 1990 having a degree in S&E, most received their entire secondary education in the United States or finished their secondary education there (59 percent); an even higher percentage (74 percent) obtained their highest degree in the United States (see tables 9 and 10).

Table 9. Country in which French citizens living as permanent residents in the United States, with degrees in science and engineering, received their secondary education

Disciplines	Secondary schooling						
	France		United States		Other		Total
Total.....	2,662	30%	5,267	59%	1,026	11%	8,955
Engineering.....	573	26	1,292	58	344	16	2,209
Life sciences.....	528	27	971	49	483	24	1,982
Math and computer science.....	324	33	655	66	16	2	995
Physical sciences.....	203	38	168	31	167	31	538
Social sciences.....	1,034	32	2,181	68	16	0	3,231

SOURCE: National Science Foundation, Division of Science Resources Studies, Scientists and Engineers Data System (SESTAT) Integrated File, 1993.

Table 10. Country in which French citizens living as permanent residents in the United States, with degrees in science and engineering, received their graduate degrees

Disciplines	Highest degree obtained in:						
	France		United States		Other		Total
Total.....	2,045	23%	6,649	74%	260	3%	8,954
Engineering.....	303	14	1,784	81	122	6	2,209
Life sciences.....	569	29	1,412	71	0	0	1,981
Math and computer science.....	255	26	740	74	0	0	995
Physical sciences.....	65	12	335	62	138	26	538
Social sciences.....	853	26	2,378	74	0	0	3,231

SOURCE: National Science Foundation, Division of Science Resources Studies, Scientists and Engineers Data System (SESTAT) Integrated File, 1993.

Some variation by discipline is evident among the general trends. For example, of the French citizens having their highest degree in engineering, 81 percent were either entirely educated in the United States or finished their degrees in the United States. On the other hand, only 62 percent of those with degrees in the physical sciences pursued or finished their studies in the United States.

At all levels of education, French citizens with degrees in S&E and living in the United States as permanent residents were more often educated in the United States than in France.

Influence of Secondary Studies in the United States on Choice of Discipline. The data in table 9 allows a concentrated look at the population of French citizens in the United States with degrees in S&E who completed their secondary education in the United States. The degrees obtained by these 5,270 individuals are distributed as follows:

- 25 percent in engineering (1,290 diplomas),
- 18.5 percent in the life sciences (970 diplomas),

- 12.5 percent in mathematics and computer science (655 diplomas),
- 3 percent in the physical sciences (168 diplomas), and
- 41 percent in the social sciences (2,181 diplomas).

For the purposes of comparison, degrees awarded in the United States in S&E (bachelor's, master's, and doctorates together) over the last 20 years are distributed in about the same way:

- 21.2 percent in engineering,
- 16.6 percent in the life sciences,
- 12.0 percent in mathematics and computer science,
- 7.2 percent in the physical sciences, and
- 43 percent in the social sciences.

One conclusion naturally arises from the similarity of these distributions: French citizens who obtain their secondary education in the United States tend to follow the same paths in college and graduate studies as their American counterparts.

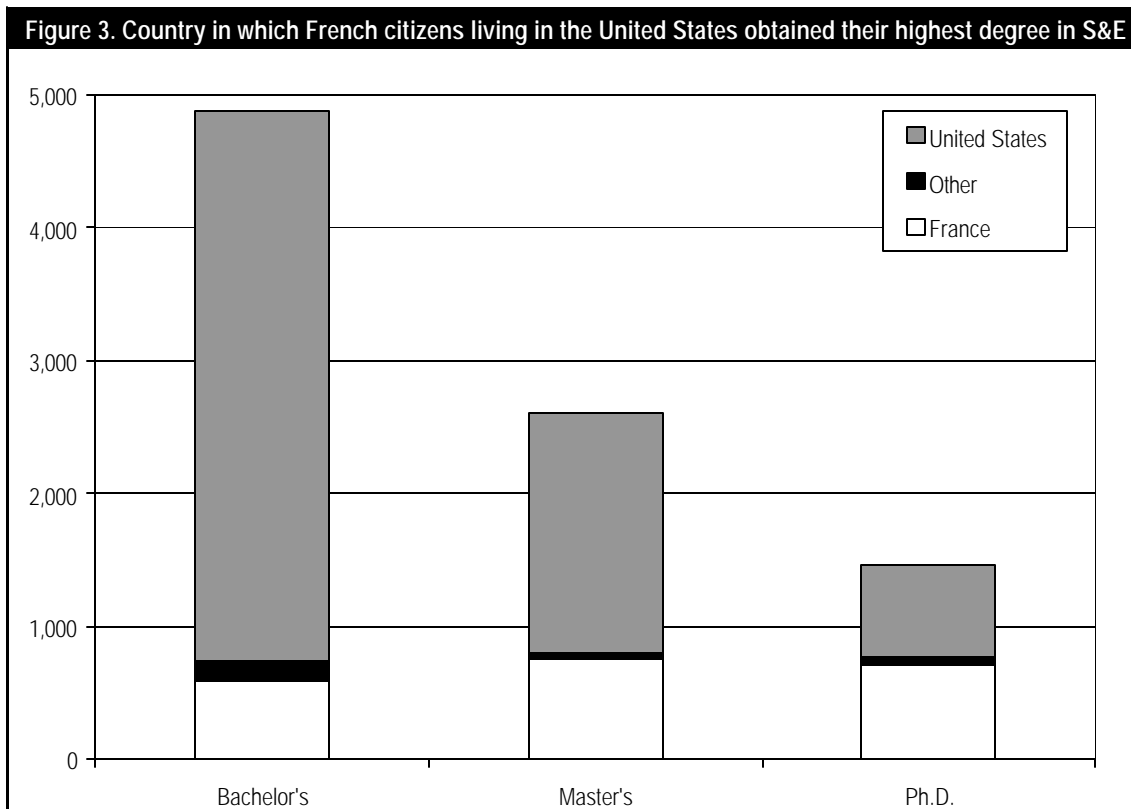
Country in Which the S&E Degree Was Obtained, by Level of Degree. If we look at the country in which the highest diploma was obtained by level of degree (bachelor's, master's, Ph.D.), one trait is immediately apparent: the proportion of French diplomas in S&E increases with level of degree. Most of those surveyed who have a bachelor's degree (or equivalent) as their highest level diploma obtained that degree in the United States (figure 3). This means that few French citizens who come to the United States with a college education do not pursue a higher degree. At the master's stage, 30 percent of those surveyed have a French diploma. The proportion is as high as 48 percent among those with doctorates.

French S&E Ph.D.s in the United States. There were 1,470 French citizens with a Ph.D. from the United States, France, or elsewhere surveyed in the United States in 1990. Their distribution by place of origin of their diplomas was:

- 710 doctorates from France (48.5 percent),
- 700 doctorates from the United States (47.5 percent), and
- 60 doctorates from third countries (4 percent).

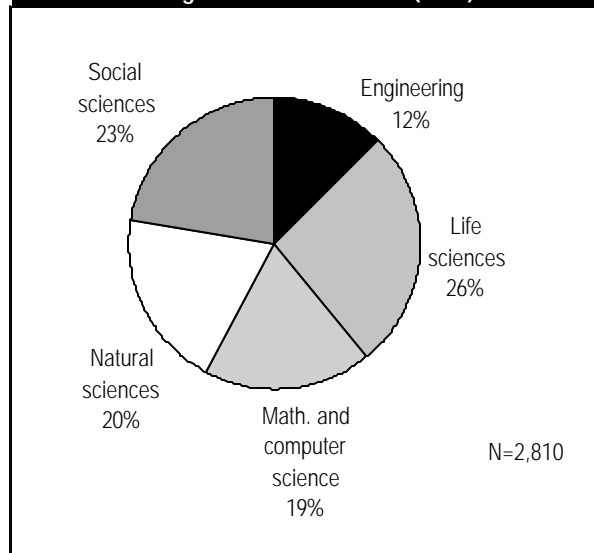
Putting aside the question of the place of origin of these degrees, it is interesting to look at the distribution by specialty (figure 4) and to compare it to the distribution of doctorates awarded by American universities (figure 5). Between 1980 and 1993, doctorates in mathematics and computer science comprised only 6 percent of all doctorates in S&E awarded in the United States. However, 19 percent of French S&E doctorate-holders living in the United States as permanent residents were in those disciplines.

Another significant difference appears in the field of the social sciences, which represents 32 percent of the American S&E doctorates but only 23 percent of doctorates obtained by French citizens living in the United States as permanent residents.



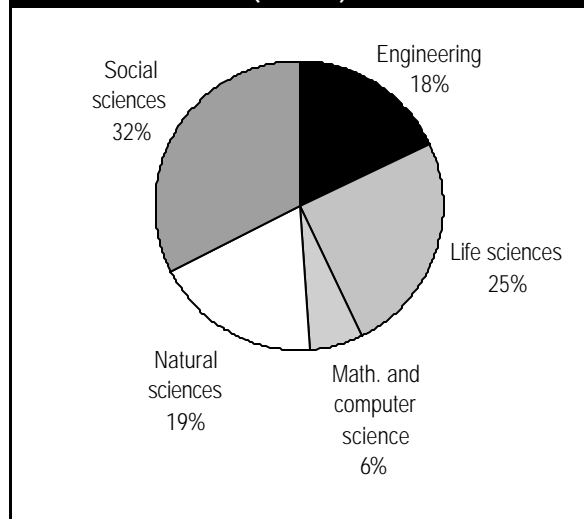
SOURCE: National Science Foundation, Division of Science Resources Studies, Scientists and Engineers Data System (SESTAT) Integrated File, 1993.

Figure 4. Doctorates held by French people living in the United States (1993)



SOURCE: National Science Foundation, Division of Science Resources Studies, Scientists and Engineers Data System (SESTAT) Integrated File, 1993.

Figure 5. S&E doctorates awarded by U.S. universities (1980-93)



SOURCE: National Science Foundation, Division of Science Resources Studies, Selected Data on Science and Engineering Doctorate Awards, 1996.

Conclusion. Most of the 9,000 French citizens living permanently in the United States and having a graduate degree have pursued their secondary education in the United States, and three-fourths of them obtained their highest level diploma there. However, when looking at only those with the highest level degrees, the trend is reversed. Among those 1,500 S&E doctorate-holders, almost half have French doctorates. *Of all the persons educated in France, those with doctorates represent the highest proportion of those who are “lost” to France.*

MIGRATION OF FRENCH SCIENTISTS AND ENGINEERS TO THE UNITED STATES

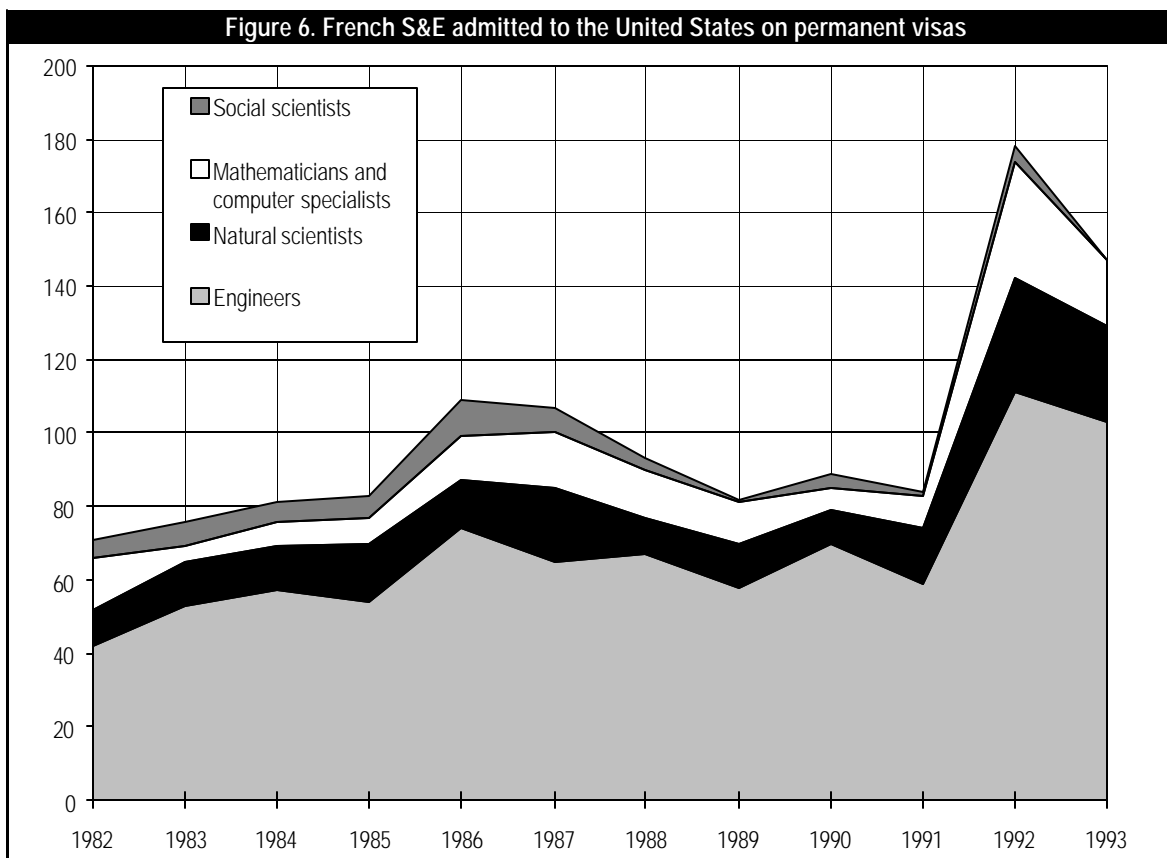
The data used in this section were obtained from the U.S. Immigration and Naturalization Service (INS), the department charged with regulating immigration. An immigrant is an alien admitted to the United States as a legal resident. The INS provided NSF with data on those immigrants who declared themselves to be scientists or engineers, and whose curriculum justified that designation. Those who declared themselves to be researchers, managers, teachers, or students were not included in the figures. Neither were those who did not declare a profession. Therefore, the following figures are perforce underestimates of the actuality.

It is important to note, also, that among the French immigrants in S&E are some who have lived in the United States for several years, but on temporary visas. They may have, for example, obtained a doctorate or filled a postdoctoral position in the United States, but they will not appear in the figures from immigration until they become permanent residents.

French Scientists and Engineers Admitted to the United States as Permanent Residents. Figure 6 shows the number of French scientists and engineers admitted to the United States on permanent visas since 1982. Only those persons who declared themselves as belonging to one of the four professional categories appear in the figure.

A significant increase is readily apparent in 1992. This was the year the Immigration Act, passed in 1990, took effect. It put into place the first major changes in immigration quotas in 25 years. This law raised immigration quotas for professionals, bringing a strong increase in the number of highly qualified immigrants—among whom are engineers and scientists. (Note that the year 1992 shows as a plateau in figures 6 and 7, due to the 1990 Immigration Act.)

Scientists and Engineers Admitted to the United States Whose Last Country of Residence Was France. In this category, it is not country of origin that is chosen but country of last residence (figure 7). Of the engineers and scientists coming from France to the United States, many are French citizens and were included in the previous subsection analysis. In 1990, for example,



SOURCE: National Science Foundation, Division of Science Resources Studies; U.S. Department of Justice/Immigration and Naturalization Service, unpublished tabulations.

140 scientists and engineers came to the United States from France, and 82 of them were French citizens. That same year, 89 French scientists and engineers were registered by the INS. Seven of those, therefore, came from a country other than France. Additionally, 58 engineers and scientists who were not French citizens left France in 1990 for the United States.

Status of Scientists and Engineers From France: Work Permits. Generally, persons immigrating to the United States for professional reasons, as well as temporary, non-immigrant, workers, must obtain a labor certification from the U.S. Department of Labor. Approximately one person in three comes to the United States for professional reasons; the other two-thirds come because of family or as refugees. One in three immigrants here for professional reasons is exempted from the need for a labor certification. This exemption is most often awarded to highly qualified people, including scientists.

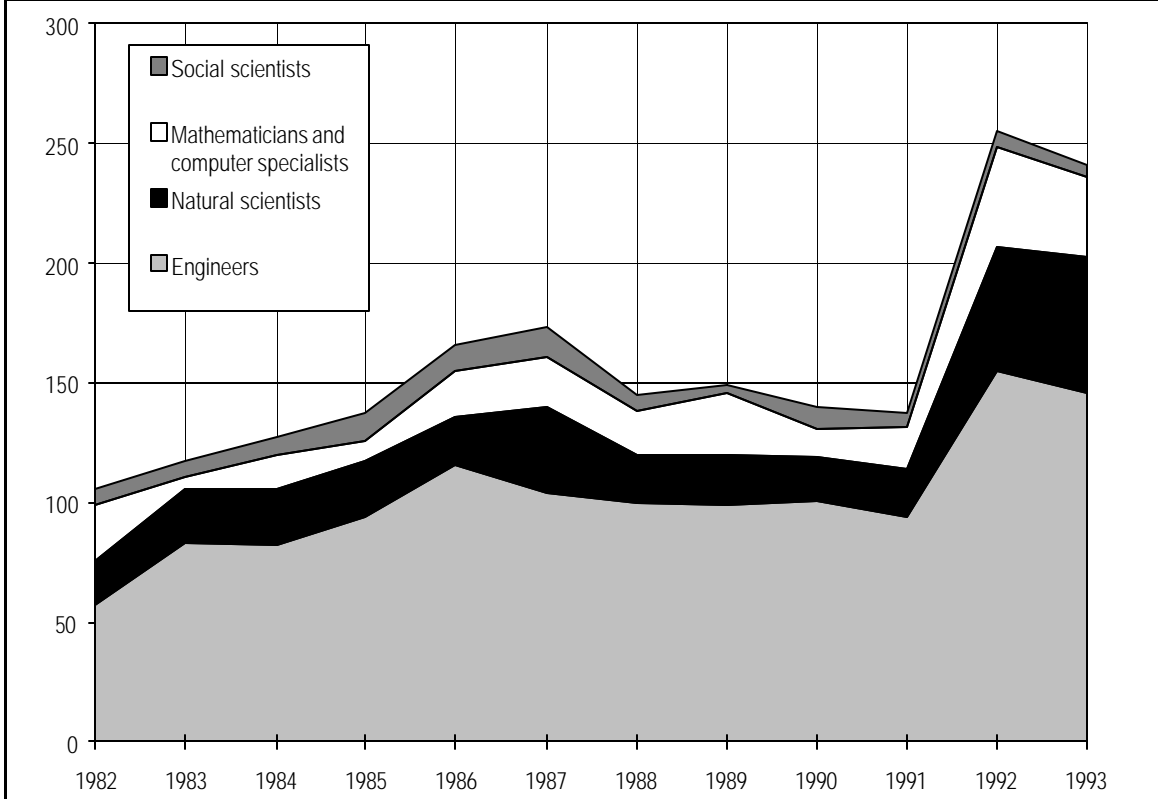
Among those scientists and engineers coming from France, only some immigrate for professional reasons; of those, not all are required to obtain a labor certification. These considerations explain the data in figure 8.

Geographic Origin of Scientists and Engineers Coming From France but Not French Citizens. Each year, scientists and engineers who are not French citizens leave France for the United States. The INS counted between 60 and 80 of them every year between 1984 and 1993. These figures are certainly underestimated, once again due to the number of immigrants whose professions are unknown. With this understood, it is still interesting to look at their distribution according to country of origin.

Figure 9 gives the aggregate of this distribution over the years 1984-93. The evolution of this distribution over time is not different enough to be significant. Overall, the scientists and engineers who lived in France before emigrating to the United States came from the Near and Middle East, the Far East, and Africa.

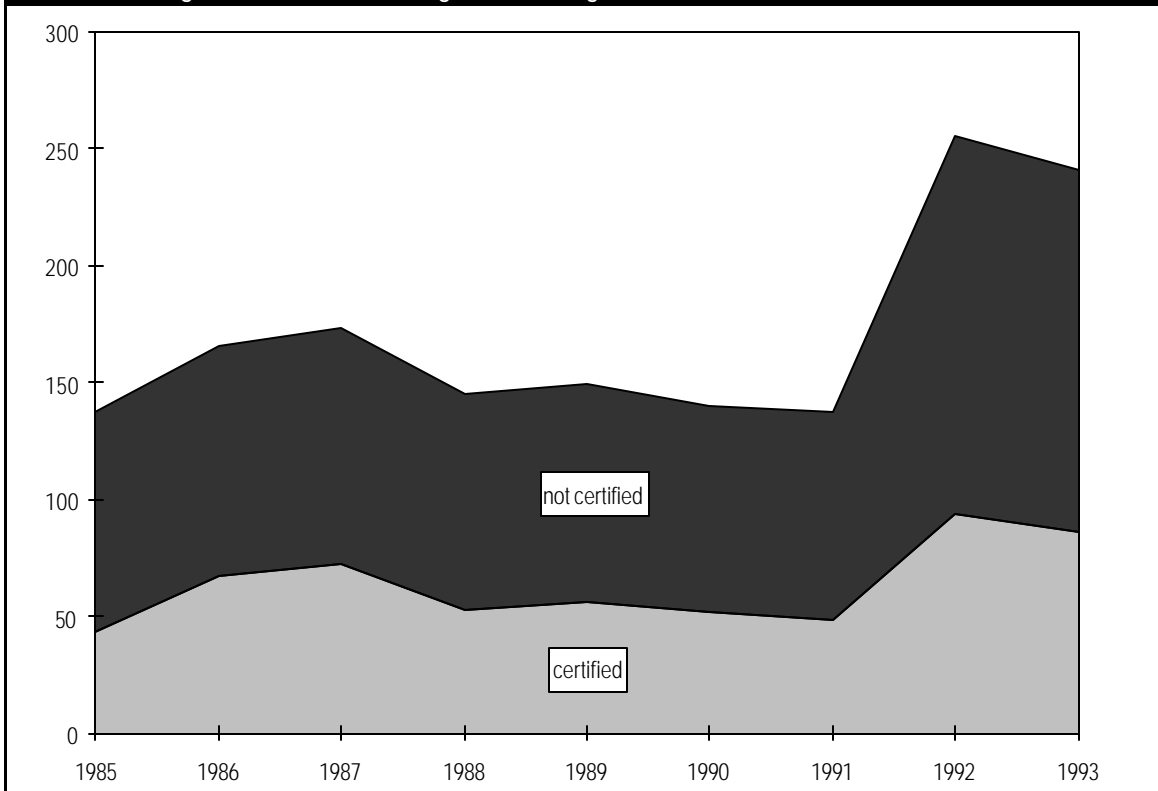
It is instructive to look at the parallels between this distribution and that of country of origin of noncitizens obtaining doctorates in France in 1995 (figure 10). Obviously, it is not advisable to make too much of this comparison because the two figures do not compare the same population. Still, it is interesting to see that Africa, which is the point of origin of more than half the noncitizens

Figure 7. S&E admitted to the United States on permanent visas, last permanent residence is France



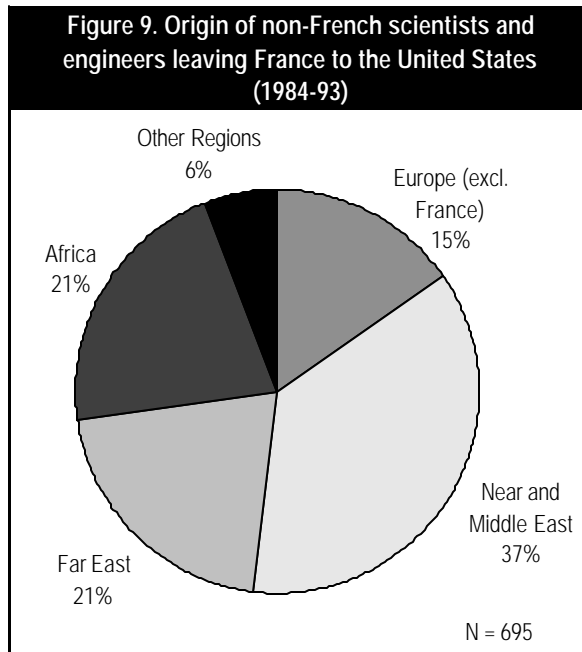
SOURCE: National Science Foundation, Division of Science Resources Studies; U.S. Department of Justice/Immigration and Naturalization Service, unpublished tabulations.

Figure 8. Scientists and engineers coming from France - Labor certification status



SOURCE: National Science Foundation, Division of Science Resources Studies; U.S. Department of Justice/Immigration and Naturalization Service, unpublished tabulations.

obtaining doctorates in France, is not disproportionately represented in the population of non-French citizens who are scientists moving from France to the United States.

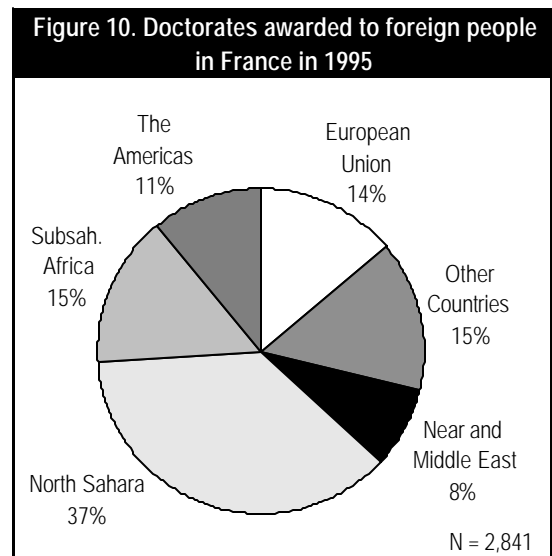


SOURCE: National Science Foundation, Division of Science Resources Studies; U.S. Department of Justice/Immigration and Naturalization Service, unpublished tabulations.

In fact, those scientists coming from the Near East and Middle East, a smaller proportion of those who get their doctorates in France (about 8 percent), leave for the United States in much higher numbers (37 percent of the immigrants coming from France but not French citizens).

FRENCH STUDENTS AND UNIVERSITY STAFF IN AMERICAN UNIVERSITIES

This section is based on data found each year in the reports *Open Doors* and *Profiles*, published by the Institute of International Education. *Open Doors* presents the results of a yearly survey of the population of foreign students registered in all American universities. Depending on the year, the rate of response of these establishments varies between 90 and 98 percent. Unfortunately, not all the universities reply with the same amount of detail. For example, in the data for 1995-96, the universities registered a total of 453,800 foreign students, but those conducting the survey could only identify countries of origin for 395,000 of them, or 87.1 percent. The level of academic studies is only known for 346,000, or 76.3 percent.



SOURCE: French Ministry for Research, DGRT Rapport sur les études doctorales, December 1996.

In "*Profiles*," universities are asked to furnish data that is individual in nature on their foreign students: nationality, sex, field and year of studies, major source of funding. This request for supplemental detail reduces overall participation. In 1993-94, about 70 percent of the institutions that responded with the number of foreign students provided the individualized information. This data, all together, provided information on a sample population of 258,300 students, 57 percent of the total population counted in that year's *Open Doors*. Finally, of the individual forms filled out, not all were complete, but more than 90 percent had no more than one blank box.

Taking these problems into account, the correlation between the findings of the two surveys is still very strong: the overall distribution by sex, by level and field of study, or by geographic location is very similar in both surveys. It would be reasonable to think that these two sources of data give a fairly representative picture of the population of foreign students, specifically of French students, in the United States.

French Students in the United States: General Trends. There were 5,710 French students in American universities during the academic year 1995-96. This is 2.3 percent lower than the year before. Figure 11 shows the evolution of this number over the past decade. There is a significant increase in the number between 1984-85 and 1990-91, when France went from being the 26th to the 16th in terms of countries having the largest number of students in American universities. Since 1990-91, this population has been stable—between 5,000 and 6,000 stu-

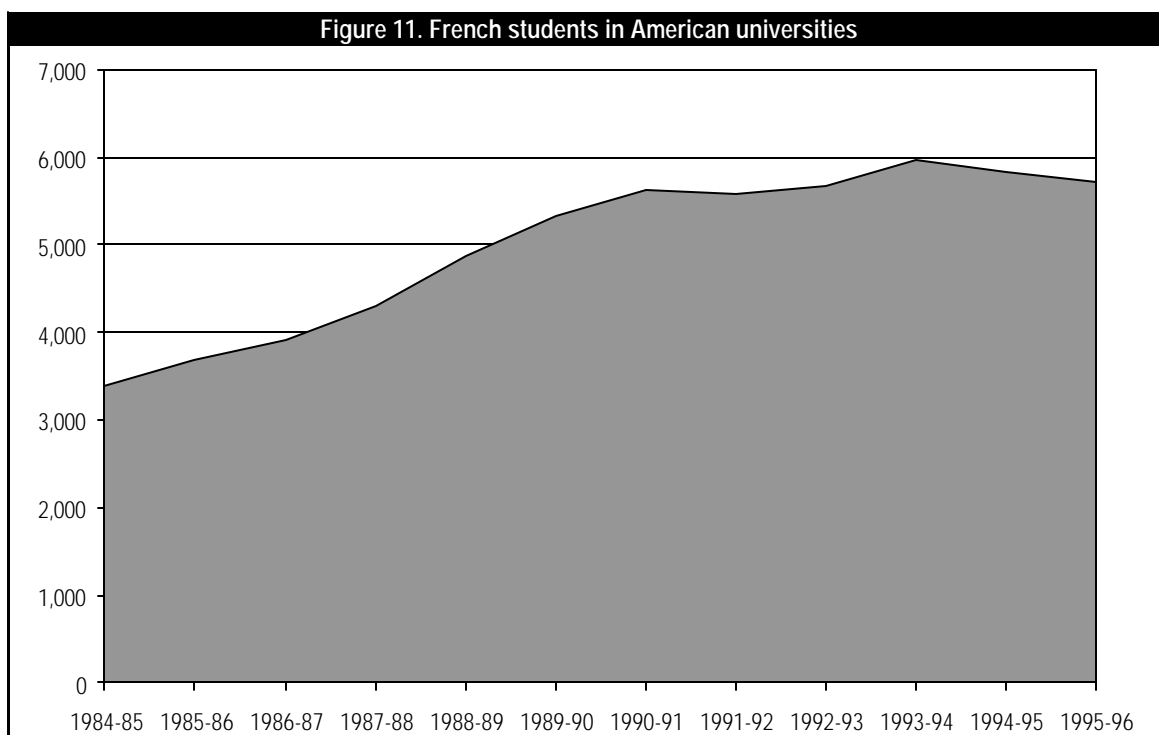
dents per year. For purposes of comparison, there are currently 8,500 German students in the United States and about 7,800 British students. France ranks third among European countries.

Figure 12 shows the change in the total number of foreign students in the United States since 1984-85. The strong increase between 1984 and 1994 is mostly due to an increase in the number of students from Asia coming to the United States. There were 145,000 Asian students in the United States in 1984-85 (42 percent of the total number of foreign students), and 260,000 in 1995-96 (more

- 702 students (12.3 percent) in other programs (intensive English, internships, etc.).

Distribution by Discipline of French Students in the United States. Table 11 gives the approximate distribution of French students in the United States by discipline, based on the findings of the *Profiles* survey of 1993-94. The field of study was known for 2,850 French students, a bit less than half of those counted in the *Open Doors* survey of the same year (5,980).

French Postdoctorates and Scientists at American Universities as Scholars. Despite the lack of precision in the term “scholar,” there is a consensus among



SOURCE: Open Doors - Institute of International Education - Report on International Educational Exchange, years 1984-85 and 1995-96.

than 57 percent of the total). Japan, China, and Taiwan are the most represented countries, each with between 35,000 and 45,000 students in American universities.

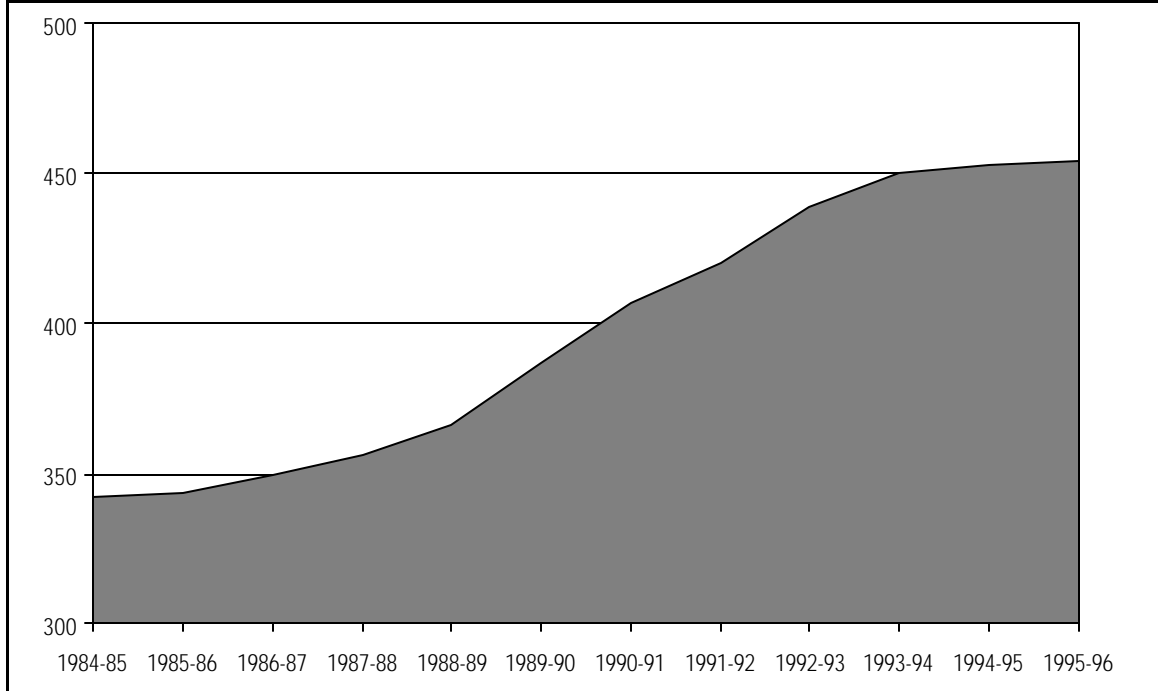
The distribution by level of studies of French students in the United States has changed little over time. Following are the figures for academic year 1995-96:

- 2,670 students (46.8 percent) in undergraduate programs (before the *maîtrise* in France);
- 2,340 students (40.9 percent) in graduate programs (after the *maîtrise*); and

universities as to how to define this category of person. The definition suggested in the *Open Doors* report is: “International scholars, being neither students nor permanent faculty, conduct research or teach or do both in a concentrated period of time, usually less than three years.” The scholar category thus includes people in postdoctoral internships as well as established scientists and academics sent “en mission” for a predetermined length of time in an American laboratory.

Table 12 gives an idea of the number of scholars counted in the United States over the past few years. Once again, this information comes from a survey of the

Figure 12. Foreign students in American universities (in thousands)



SOURCE: Open Doors - Institute of International Education - Report on International Educational Exchange, years 1984-85 and 1995-96.

Table 11. Distribution by discipline of French students in the United States (1993-94)

Total number of French students counted ("Open Doors").....	5,976
Number of students whose discipline is known ("Profiles").....	2,845
Percent of Students Whose Discipline is Known	
Commerce - Management.....	30.8%
Engineering.....	10.7%
English literature.....	9.6%
Social sciences.....	6.6%
Physical and life sciences.....	5.5%
Beaux-arts.....	3.8%
Mathematics and computer science.....	3.0%
Other (<3%).....	14.5%
Not indicated.....	15.3%

SOURCE: "Profiles" - Institute of International Education, Report on International Exchange, 1994-95.

universities, with rates of return each year between 80 and 90 percent. The figures given are thus necessarily slight underestimates of reality.

While France ranks 16th in terms of numbers of citizens in American universities, it ranks 8th in terms of number of scholars in those same universities. This discrepancy is an indication of the strength of French research.

The *Open Doors* report provides information on the types of visas held by scholars, without an indication as to country of origin. Among the 58,000 scholars counted during academic year 1994-95, 76.6 percent held a J1 visa. The U.S. Information Agency office for exchange programs in teaching, research, or education issues this visa. Postdoctorates usually have this type of visa, as well as many of the scientists coming to work in American laboratories. The other type of visa scientists and aca-

Table 12. Number of French postdocs and scientists in American universities as scholars

Year	Scholars
1989-90.....	1,810
1991-92.....	2,175
1993-94.....	2,076
1994-95.....	2,410
1995-96.....	2,320

SOURCE: "Open Doors" report by the Institute of International Education, Report on International Exchange, 1984-85 to 1995-96.

demics may obtain is the H1 visa; this was issued to 16 percent of the scholars surveyed. This visa is given to highly skilled people or to those who bring a type of knowledge or ability that is not available in the United States.

Unfortunately, it is not possible to isolate postdoctorates from scholars from the figures available in the *Open Doors* report. Despite this, NSF estimates that the total number of foreign postdoctorates in American universities is about 17,300. Among the 58,000 foreign scholars in American universities, only about 30 percent fill postdoctoral positions. The same ratio applied to the French scholars population shows that about 700 French postdoctorates work in American universities. About 60 percent of all foreign postdoctorates in the United States, of any nationality, work in a university. By applying the general ratio of foreign scholars/postdoctorates to the number of French scholars counted, we get a total number of slightly more than 1,100 French postdoctorates in the United States.

Conclusion. American universities take in about 5,800 French students each year. Almost half of them are undergraduates (before the bachelor's degree). Studies in commerce and management attract almost one-third of the French students, and science and engineering only about one-fourth. The available data do not allow us to compare country of origin, chosen discipline, and level of studies. It is, however, reasonable to assume that there would be a much higher percentage of scientific disciplines found at the graduate level (master's and doctorate) among the French students, as is the case for students from many other countries.

The American universities surveyed counted about 2,300 French scholars per year. These scholars are temporary visitors, often holding J1 visas; postdoctorates; academics; or visiting scientists. A minority of scholars are postdoctorates.

DOCTORAL CANDIDATES IN THE UNITED STATES

The data used in this section come from the National Research Council's annual Survey on Doctorate Recipients for NSF and four other federal agencies. The information is collected via questionnaire directly from doctoral candidates just before their thesis defense. While answering the questions is not required of the candidates, most do so, finding no difference between this survey and the other administrative papers they must fill out when they get their degrees. In this way, the rate of response has consistently stayed between 92 and 94 percent over the past 10 years.

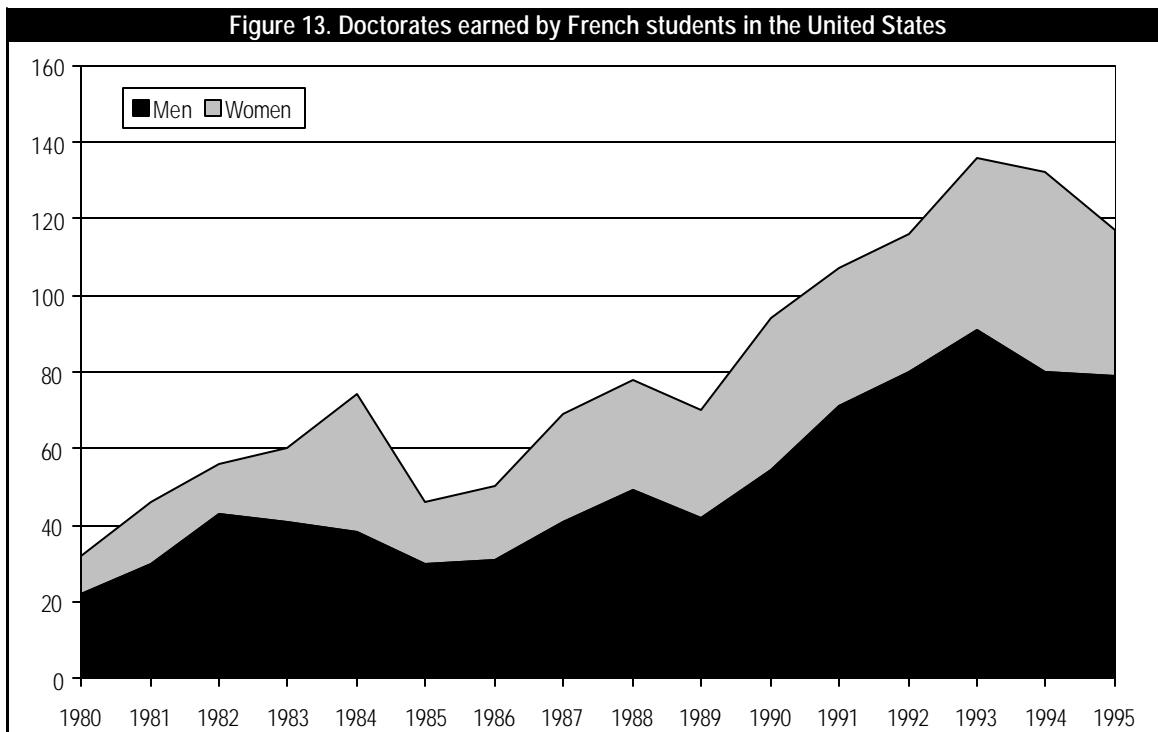
Total Number of French Doctoral Candidates in the United States, in All Fields of Study. Figure 13 shows the evolution of the number of doctorates awarded to French citizens in the United States between 1985 and 1995 in all disciplines. This population has remained relatively small, despite having more than doubled in 10 years (117 doctorates in 1995, against 46 in 1985). All categories of doctorates, encompassing those in S&E as well, are included. Distribution by sex has stayed basically the same between 1985 and 1995: about one-third of doctorates are awarded to women (35 percent in 1985, 40 percent in 1990, 32 percent in 1995, and 36 percent on average over the entire period under consideration). If only the S&E fields are examined, the proportion of women receiving doctorates is a bit lower: 23.5 percent between 1987 and 1991.

Profile of French Citizens Getting a Doctorate in the United States. Table 13 contains information presenting a profile of the 1,015 French citizens who obtained a doctorate in the United States between 1985 and 1995. During that decade, 30 percent had a permanent visa and were the most likely to remain for long periods in the United States.

The average time between getting a bachelor's degree and obtaining a Ph.D. was 7.4 years. The time spent solely in the university was 6.2 years. These averages are lower than those of all U.S. doctorate recipients in all disciplines, whose average time at the university was 7.2 years, with 10.9 years between getting the two degrees.

The 1-year difference between the university time of French citizens as compared to all doctoral candidates is related to the fact that more French students pursue disciplines requiring shorter terms of university study (engineering, for example, which attracts almost one-fourth of French doctoral candidates in the United States). The more significant difference (more than 3 years) in the total period between the bachelor's and the Ph.D. is due in part to the U.S. practice of alternating work and the pursuit of a degree or of pursuing both work and degree concurrently. The difference between the two groups also shows that French students coming to the United States for a degree do not often adopt this dual regimen; this is mostly due to a lack of opportunity, since most of the students have only temporary visas that do not allow them to work outside of the university environment.

NSF's statistical division—the Division of Science Resource Studies—is responsible for monitoring American activity in science and technology. Therefore, some



SOURCE: National Science Foundation, Division of Science Resources Studies, Survey on Earned Doctorates, unpublished tabulations, 1996.

Table 13. Profile of French citizens who obtained doctorates in the United States 1985-95

All disciplines	Number	Percent
Total number of doctorates (1985-95).....	1,015	
Status		
Permanent visas.....	303	30
Temporary visas.....	712	70
Average time between the bachelor's and the Ph.D.		
Years since obtaining a bachelor's.....	7.4	
Years of education since obtaining a bachelor's.....	6.2	
Married.....	441	43
Planning to stay in the U.S. after getting their Ph.D.....	496	49
With a prospective postdoc or job.....	344	69
Looking for employment or a postdoc.....	144	29
Not specified.....	8	2
Science and engineering only		
Number of doctorates in science and engineering.....	695	
Average age of obtaining doctoral degree.....	29	
Plans upon receipt of doctorate		
Planning to stay in the U.S.....	287	41
Planning to leave the U.S.....	274	39
Not yet decided.....	134	19

SOURCE: National Science Foundation, Division of Science Resource Studies data, Survey on Earned Doctorates, unpublished tabulations, 1996.

of the data available at NSF from the Survey on Doctorate Recipients focus on doctorates in S&E only. An interesting figure is the average age of French recipients of American doctorates, which is 29 years. The average age of all recipients of American doctorates in S&E is 32.2 years. There is the same 3-year difference previously found in the average number of years between the undergraduate degree and the Ph.D.

The questionnaire given to doctoral candidates just prior to their thesis defense includes some questions about their plans. Great care must be taken in interpreting these responses. The French candidates filling out this questionnaire just before defending their theses know that they will need a postdoctoral position if they want to find employment with one of the public sector institutions in France. They are more predisposed, therefore, to see a short-term future in the United States. These findings, moreover, indicate only the *intentions* of future doctorate-holders; they do not actually provide any information on future careers (especially after the postdoctoral period).

About half (49 percent) of the French doctoral candidates in the United States, in all disciplines, plan to stay in this country after obtaining their degree. Two-thirds of these have a specific position or postdoctoral position arranged. The remaining one-third consists of people plan-

ning to stay, but either without specific plans or not stating those plans. In short, some months before defending their theses, one in three French students who are candidates for Ph.D.s at American universities have specific plans to stay in the United States.

In S&E, the proportion of future doctorate-holders planning to stay in the United States, either with or without an arranged position, is a bit lower (41 percent). Details on the nature of these plans or of these persons are not available.

Distribution by S&E Discipline. Between 1985 and 1995, 695 of the 1,015 doctoral degrees obtained in the United States by French citizens were in science or engineering. The distribution of these 695 doctorates by field is given in figure 14. Engineering is an extremely significant field, awarding 240 doctorates—35 percent of the total in S&E. This predominance is recent since only 12 percent of French citizens with doctorates residing in the United States obtained their degrees in engineering (see figure 6). The other field with a large percentage of candidates is the physical sciences (physics and chemistry), which attracts 23 percent of French citizens obtaining their doctorates in American universities.

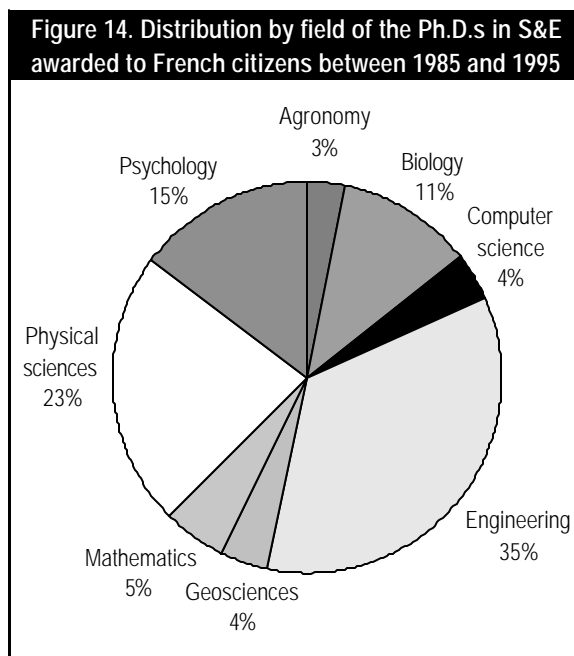
States and Universities Where French Citizens Come to Study. Two geographic areas are immediately apparent as destinations for French doctoral candidates coming to the United States:

- California, which awarded almost one-fourth of the doctorates obtained by French S&E students; and
- the Northeastern states, including the Mid-Atlantic (New York, New Jersey, Pennsylvania) and New England (Massachusetts, Connecticut, Rhode Island), which together account for 35 percent of the total.

Table 14. Science and engineering doctorates awarded to French citizens in American universities by state and university (1980-91)

State	S&E Ph.D.s	University	S&E Ph.D.s
Total.....	505	Total.....	505
California.....	117	MIT.....	32
New York.....	63	Stanford.....	31
Massachusetts.....	52	Berkeley.....	23
Texas.....	41	U. of Houston.....	21
Illinois.....	30	Columbia University.....	18
Pennsylvania.....	23	UCLA.....	16
Colorado.....	16	Cornell University.....	14
New Jersey.....	14	UC San Diego.....	13
Connecticut.....	13	Northwestern Univ.....	12
Indiana.....	13	U. of Pennsylvania.....	12
Michigan.....	12	Yale.....	11
Rhode Island.....	11	Illinois Inst. of Tech.....	10
Georgia.....	10	Princeton University.....	10
Other states (<10)....	90	U. of Rochester.....	10
		U. of Texas at Austin.....	10
		Other universities (<10)....	262

SOURCE: National Science Foundation, Division of Science Resources Studies data, Survey on Earned Doctorates, unpublished tabulations, 1996.



SOURCE: National Science Foundation, Division of Science Resources Studies data, Survey on Earned Doctorates, unpublished tabulations, 1996.

These same two geographic areas are found in the survey of doctoral candidates and postdoctorates in North America, the subject of the next section.

CONCLUSION

Currently, there are 1,500 young French scientists in the United States either pursuing a doctorate or in postdoctoral positions. The often feared brain drain, if in fact it does exist, applies to a relatively small population.

While assembling information from these young scientists, it seems that many of them remain interested in France and want to return there one day for a career in

higher education or public research. Their education taught them a love of purely intellectual activity that can be found only in basic research; their early experiences as researchers, as doctoral candidates, and—later—in postdoctoral positions confirmed this preference while also failing to instill an interest in the more applied research that industry offers. This categorical rejection of the value of applied research is often a problem when they seek professional positions—and leads to some bitterness with the French educational system if they have difficulties finding interesting jobs.

While the French university system can be criticized for its lack of interest in the industrial sector, industry shares the responsibility in that it has systematically given preference to students and graduates of engineering and business schools, first in internships and later when hiring.

When stated thus, the problem may seem typically French. The United States, however, is also reexamining the future of its young doctorate-holders and questioning the pertinence of graduate education. In the United States as in France, the educational system does not seem to encourage careers in the industrial sector. The postdoctoral positions are, in the United States,

synonymous with uncertainty. The low unemployment rate in the United States makes the problem less urgent.

The gravity of the employment situation in France, even for the best educated, exacerbates the bitterness of these young expatriate scientists. This is particularly evident when those reactions examined in this study are compared to those evinced in the same type of survey 10 years ago. Initiatives such as the *doctoriales*—training designed to help doctorate-holders find employment in the industrial sector—are steps in the right direction. The efforts of the Association Bernard Gregory, whose mission is to find jobs for Ph.D.s in industry; and the activities of the French Office of Science and Technology in Washington that created the Forum USA, an annual job fair at which French scientists in the United States have the opportunity to meet with employers from France in three American cities, will help integrate researchers into the French private sector.

France is aware of this call from its young scientists in the United States. Their futures are tied to the health of higher education, research, innovation, and industry in France. This may be a brain drain, but it is one in which those who have left would like nothing better than a ticket home.