

Women in Science in France

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Argument

In France 15 per cent of university professors are women. Though this percentage is not high, France ranks among the top European countries in this regard. We argue that the “relatively favorable” situation of French women scientists is related to the social structure of French society, in particular its child-care system, and to the stable permanent positions in academia, where people are hired in their early thirties. French women scientists experience less difficulty than other European colleagues to manage both a private and a professional life. We also argue that the weak position of French gender studies stems from its lack of institutionalization, and from the isolation of the single researchers in their specialized disciplines. Finally we argue that the French recent interest in the issue of women and science is specifically related to the general interest, since the mid-1990s, in the political parity problem.

Introduction

This article focuses on French women in academic science and engineering, and on their education. It will not deal with women technicians or science teachers about whom there is less data. The paper discusses milestones in women’s education in France within the context of political struggles surrounding sexual equality. It then analyses women’s place in scientific employment and recent data relating to universities and research institutes. The unique French dual university-*Grande Ecole* system will then be explained with a focus on failure of co-education in *the Ecoles Normales Supérieures*. The final section describes current government actions to improve the situation for French women in science.

1. Historical Background

a. Milestones in Women’s Education

Public education for women in France developed in the nineteenth and twentieth centuries (Montreynaud [1992] 2000; Préfecture d’Ile-de-France 1995; Hulin

2002). The *lycées* (secondary public schools) created by Napoléon in 1808 were closed to women. Primary schools for girls were first established in 1836, and the first women's *école normale* (school to educate primary school teachers) was opened in 1838. Girls' education was not compulsory at that time and their curriculum was not comparable to that of boys. The first woman to complete her *baccalauréat* (examination ending secondary school and giving access to university) was Julie Daubié in 1861. She prepared herself for this exam and was allowed to sit for it only after Empress Eugenia intervened.

Great strides forward in girls' education came after the establishment of the Third Republic, which followed the defeat of France by Bismarck's Prussia in 1870. In 1882, minister of education Jules Ferry passed a law requiring public primary education for all children starting at age six, in efforts to undermine the influence of the Church in education. The curriculum was designed to educate girls to be "good" mothers and housewives. Girls' public *lycées* were opened, and in 1881 the *Ecole Normale Supérieure de Sèvres* was created to educate female teachers for girls' *lycées*. *Ecole Normale Supérieure de la rue d'Ulm*, which trained male teachers for employment in boys' *lycées* had been established in 1794.

At that time the curriculum of girls' *lycées* did not give access to university. At the end of the nineteenth century, however, a few female students, mostly foreigners, began taking university courses. In 1881, Blanche Edwards passed the *externat de médecine* (competitive medicine exam to become a medical student in a hospital). Her male classmates were so outraged that they burned her in effigy in the street.

The story of Marie Slodowska-Curie, who emigrated from Poland to France to prepare for a Ph.D. in physics and chemistry, is well known. In 1903 Henri Becquerel, Pierre and Marie Curie were jointly awarded the Nobel Prize for physics for their discovery of radioactivity. After her husband died in an accident, Marie Curie took his place becoming the first woman appointed professor at the Sorbonne in 1906. Despite the fact that she was the first person ever to receive a second Nobel Prize (1911), that she was awarded alone this time, she was never admitted to the French Academy of Sciences; being a woman and a foreigner prevented her acceptance into this very select assembly. In fact it was only in 1979 that a first woman, the mathematician Yvonne Choquet-Bruhat, was admitted to the Academy of Sciences. Six women out of a total of 139 members currently belong to this institution.

The diploma for girls' secondary schools was upgraded to a *baccalauréat* in 1919 and *baccalauréats* for girls' and boys' were put on an equal footing in 1924, finally allowing women equal access to universities (at least in theory). Public primary and secondary schools in France gradually became co-educational in the 1960s and early 1970s. Women's and men's *Ecoles Normales Supérieures* were merged in the 1980s in such a way that the percentages of women admitted in physics and particularly in mathematics dropped dramatically (see §4.b). Women were gradually admitted to French engineering schools (see §4.c); the last engineering school to accept women

was the military School for Aviation (*Ecole de l'Air*) in 1978. Today girls outnumber boys until the third year of university studies, and there are many women teachers and professors, even if they are still few in the education decision-making positions (Feldman et al. 1994; Fave-Bonnet 1996).

b. Politics

In order to understand the history of women in French science, one must look more generally at the situation of women in French politics. French women obtained the right to vote in 1944, at the end of World War II. The Parliament had, in fact, voted for this right in the 1930s, but the law was not passed due to the lack of Senatorial support. The left-union (socialists, radicals, communists) *Front Populaire* (Popular Front) government of 1936 had three women deputy-state secretaries, including Irène Joliot-Curie, the daughter of Pierre and Marie Curie, who had been awarded the Nobel Prize for physics jointly with her husband Frédéric Joliot-Curie in 1935 for the discovery of artificial radioactivity. Irène Joliot-Curie served as deputy-state secretary for research.

Throughout the second half of the twentieth century, the percentage of women in the French Parliament remained low. Up to 2002 women represented approximately 10 per cent of Parliamentary members, ranking France second-to-last among the European Union member states. After the June 2002 election, women's participation reached 12 per cent (71 women out of 577 members). As women became dissatisfied with this unfair situation in the 1990s, an association called *Demain la Parité*¹ (Parity Tomorrow) was created. Its members realized that the problem of the under-representation of women was not unique to French politics: it occurred more generally in all channels leading to power. One road to decision-making positions in France is to be alumnus (alumna) of a *Grande Ecole*. As is well known, French higher education has two distinct tracks (see section 4): the universities and the elite *Grandes Ecoles* (literally, "Great Schools," the French equivalent of the Ivy League in the United States). Of the *Grandes Ecoles* (in the areas of engineering, agriculture, business, and administration), the scientific ones are particularly prestigious. Former president Giscard d'Estaing and numerous major French company presidents were educated at the *Ecole Polytechnique*, for example. In view of this, *Demain la Parité* commissioned a study of the representation and situation of women in the engineering schools and in the classes that prepare students for the corresponding competitive admission exams. Two heavily documented reports were issued under the

¹ <http://int-evry.fr/demain-la-parite>.

direction of Huguette Delavault, a retired university professor of mathematics. The first one is on the place of women in scientific *classes préparatoires* (see §4; Delavault 1997), the second one on the engineering *grandes écoles* (Delavault 1998). These studies had a major impact in the academic circles and in the education media.

Between 1998 and 2002, French Prime Minister Lionel Jospin championed *parité* (sex equality, particularly in politics). A recent law (2002) has introduced the paternity leave of 11 days to be taken within 4 months following the baby's birth. In politics a law was passed requiring equal numbers of men and women's names on proportional ballot elections (candidates elected from lists) in cities with more than 3,500 inhabitants. For parliamentary ballots, according to the same law the political parties presenting an unequal number of candidates at the national level would be fined. This law was applied for the first time in March 2001 in local elections with the result that women hold 47 percent of municipal offices but only 10.9 per cent of the mayoral positions (Génisson 2002).

On the same issue, Prime Minister Jospin ordered numerous reports on the position of women in French society: in the top positions of civil service (Colmou 1999); in the professions (Génisson 1999); in the economy (Majnoni d'Intignano 1999); and in decision making (Cotta 2000). C. Blum's report on the availability of sex-disaggregated statistics in France concluded that such data are reasonably collected, but insufficiently analyzed or publicized. In response, Prime Minister Jospin issued a memorandum in March 2000 requiring that all published statistics should be sex-disaggregated.

In 1998, the Research Directorate-General of the European Union, under the direction of Edith Cresson, Commissioner for Education and Research, turned the spotlight onto the question of women in science (European Commission 1999). The creation in 1998 of the Women and Science Sector (which became a Unit in 2001) was essential to introducing this question into many European Union circles. The status-quo of women scientists in Europe was elaborated in the European Technology Assessment Network (European Commission 2000) (one of the authors of this article, C.H., was an expert in the group that produced this report); this report was approved by the present Commissioner for research, Philippe Busquin, and has been widely publicized throughout Europe (see §3). The combined action of the Research Directorate-General and the European Member States is now continuing, in particular through the establishment of a group of civil servants from the European Union member states and the associated states responsible for issues surrounding women's participation in the sciences. This group is known as the EU Helsinki group. The mission of these civil servants is to provide sex-disaggregated statistics, to exchange good practices regarding women and science, and to initiate new actions in their own countries. A first report on their progress was made to the European Parliament in December 2000 and the report "National Policies on Women and Science in Europe," a synthesis of their first two years' work, was issued in June 2002 (European Commission 2002).

c. *Gender Studies*²

While the Northern European (especially Scandinavian) countries were highly efficient in ameliorating conditions for women in science, France has not been able, despite strong mobilization during the 1980s, to improve the situation. One reasonable explanation may be found in the different philosophies that subtend actions in favor of women in science in the two regions. Scandinavian and English political philosophy recognizes two sexes and genders, the unequal social construction built around them, and the necessity to take specific measures in favor of women. The claimed universality of rights, which characterizes French law, situates France in a quite different philosophical tradition.

Gender issues are thus analyzed within different frameworks beginning in the 1970s. In France, materialist theoreticians like Colette Guillaumin (1992), Christine Delphy (1998–2001), and Nicole-Claude Mathieu (1991) introduced concepts like *classe sociale de sexe* (sex as a social class), and *rappports sociaux de sexe* (social sex relations), that did not take into account a feminine specificity relating to females' reproductive capacities. On the contrary, they reject any reference to naturalism and claim that the hierarchy between the two sexes is a historical and social, thus an arbitrary, construct. The Marxist notions of struggle between sex classes and oppression are used instead. Women exist as a social class dominated by that of men who use them mainly to perform reproductive work. "Il n'y a de femmes que pour autant qu'un rapport de force inégalitaire fait de l'oppression et de l'exploitation d'un groupe social la condition du pouvoir de l'autre" (Women exist only as far as an unequal power relation transforms the oppression and exploitation of a social group into the condition of the other group's power) one could read in the first issue of *Questions féministes* (n°1, p.19).

According to the theoretical orientations inherent in the concept *rappports sociaux de sexe*, it was first used and applied in domains like sociology, anthropology, and history, even if women's history developed autonomously and on different epistemological assumptions inside the academic institutions, with the support of Rita Thalmann and Michelle Perrot (cf. Perrot's assessment in Gardey and Löwy 2000, 59–73). Feminist study groups were founded at various universities, the first one being *Centre d'Etudes Féminines de l'Université de Provence* (CEFUP) in Aix-en-Provence, followed by *Groupe d'Etudes Féministes* (GEF) in Paris 7, *Centre Lyonnais d'Etudes Féministes* (CLEF) in Lyon 2, *Groupe de Recherche Interdisciplinaire d'Etude des Femmes* (GRIEF) in Toulouse, and so on. These groups were quite active in organizing conferences and publishing journals or bulletins (for instance, Daune-Richard et al. 1989).

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The natural sciences were outside the realm of feminist critique as it developed in close contact to the women's movement in France. Informal groups began, however, to meet toward the end of the 1970s (Peiffer 2000) and to reflect on their situation as women in the sciences. The first meeting was prompted by the publication of *Le fait féminin* (1978), where sociologist Evelyne Sullerot, arguing against Simone de Beauvoir, held that women are, indeed, born women with a different anatomical fate. Furthermore, women researchers in the trade unions (Syndicat National des Chercheurs Scientifiques, SNCS) compiled statistics concerning women and their scientific careers. They also investigated women's personal experiences within the various scientific professions (Commission femmes du SNCS 1981).

Several projects grew out of these first gatherings (cf. *Pénélope* 4 1981 for a short presentation). An especially original one was without doubt the seminar entitled Limits/Frontiers (1980–1988) held in Paris. This women-only seminar was to be interdisciplinary, drawing participants from widely diverse fields from literature to the natural sciences; it was also to take place outside the boundaries of conventional academic institutions. The understanding of interdisciplinary work inside research institutions was at that time far too narrow to support such an enterprise. During its eight-year run, this seminar allowed women from various feminist and research traditions the freedom to test hypotheses and cast theories sometimes even in language not accepted by traditional institutions (cf. Séminaire Limites-Frontières and Rouch 1986).

In addition to Marxism, the dominant intellectual discourse in 1970s' France was psychoanalysis, dominated by Jacques Lacan's attempt to formalize its concepts. Rooted in that culture, the founding members built the Limits/Frontiers seminar on the following assumption: the sciences, as well as other intellectual ventures, are nourished with images, pictures, and metaphors. These images might not be the same for men and for women, given their different social inscriptions and given their different places in the hierarchical order between the two sex classes. Experiencing oppression or exerting domination do not necessarily lead to the same construction of knowledge. Science done from the bottom up, from the "grassroots" (to use the metaphor of the time), could differ significantly from official science. Thus the question of sexist bias in academic science was an important one to explore. Does the gendered identity of the scientist play a role in the production of knowledge? The emphasis was more on the individual scientist, on the results produced, than on the social organization of science, its rhetoric, or its values. But, ultimately not choosing between a materialist or an essentialist approach to sex differences, the seminar has proved unable to build a coherent theoretical framework to the gender-in-science question. It remained a reservoir of ideas, not dogmatic, and open to various, even contradicting approaches.

Nearly at the same time, some attempts were made to introduce a feminist standpoint and/or gender problematic into the university curricula. Toward the end of 1982, around 800 women gathered together at the university of Toulouse in order

to make a first assessment of the results obtained and to organize women's studies. The proceedings of this conference show the wide range of topics discussed and the variety of theoretical and methodological approaches (AFFER 1984; cf. in particular the sections: "Femmes, sciences et techniques," 705–734; "Critique féministe des sciences: problématique de la différence des sexes," 735–824; and "Sciences exactes–sciences humaines: Epistémologie des formalisms," 835–877). The dominant opinion was that gender studies could not be left to a handful of experts, but should be intimately linked to feminist action and women's struggles. The aim of such research was not simply to study facts, but also to change them. Thus the social and political dimension of feminist research or research on women was stressed. As a result, the *Centre national de la recherche scientifique* (CNRS) financed a program on women's and feminist research, Action thématique programmée n°6, 1984–1989 (cf. CNRS 1989–90 for an overview of the research done). The various attempts to perpetuate the program failed for a series of complex reasons internal to CNRS and because of a changed political context.

Several research groups were nevertheless created, especially in the human and social sciences, some of which are still active, like *Simone Sagesse* in Toulouse, *Groupe d'étude sur la division sociale et sexuelle du travail* (GEDISST) and *Centre d'enseignement, de documentation et de recherches pour les études féministes* (CEDREF) in Paris, etc. University positions were obtained (at the level of associate professor) in Rennes, Paris, and Toulouse; journals like *Clio*, *Les cahiers du genre (anciennement du GEDISST)*, *Les cahiers du CEDREF*, etc. were published at the initiative of some individuals; and seminars were held at the *Ecole des hautes études en sciences sociales* (EHESS). This timid institutionalization made no real attempt to change the disciplinary structure of the sciences concerned or to reorganize their architecture in order to introduce new disciplines such as gender studies.

The gender question in science has thus opened a new methodological perspective questioning the epistemological foundations of the established disciplines, but did not lead in France to an autonomous field of knowledge. Gender analysis yielded important results in the human and social sciences (Collin 1992; Fraisse et al. 1991; *Les cahiers du GRIF* 45 1990), especially in understanding women's work, but did not really touch upon the natural sciences, whose gender neutrality and objectivity were often reasserted. France did not even join the movement – today well established in the history of science – that has recovered the scientific work of women who contributed to science in the past.

While in the United States the gender studies of science came of age in the 1980s and 1990s, French research and its institutions proved too rigid. The growth of a rich and interesting field of research, growing out of the bottom of feminist struggles, was stunted before it even began. The reasons for this failure are not clear, but are partly due to the lack of institutionalization, partly to the rejection by French academic institutions of certain "radical" positions, and partly to the isolation of the single researchers in their specialized disciplines. To offset these pressures, a national

association *Association nationale d'études féministes* (ANEF) was created in 1989. It publishes a *Bulletin* three times per year and a thematic issue once a year.³

2. A Few Particular Points about French Scientific Employment

Before delving into details concerning the status of women scientists in France, let us begin with the data given in chapter 2 of the European ETAN report (European Commission 2000; see section 1b) that compares countries in Europe. According to these data, France occupies a relatively good (although not satisfactory) position in the ranking of the countries from the highest to the lowest percentages of women among university professors: the global (all disciplines) data on French faculty gives 14 per cent women among professors compared to 34 per cent women at the lower rank (§3a).

The present situation for women scientists in France results from the general conditions for working educated women. It has not been determined by any affirmative action or “quotas” that are in general not appreciated, the fear being that a woman recruited to fill a quota would be considered less qualified than a regular hire (Hermann 1997).

a. Social and Society System

Generally speaking, working conditions for women in France are rather favorable, and it is considered normal for a mother of young children to work. An infant-care system, even if not perfect and varying by town and region, does exist. The *école maternelle* (public pre-school system for children from 3 to 6 years of age) is free, open (except holidays) from morning to late afternoon, and attended by more than 90 per cent of all children, even at 2½ years of age. In addition the law permits parental leave until the child is 3 years old (unpaid, but the position is kept for the parent), an option used mostly by mothers, and tax deductions are available for child care costs (until the child is 6 years old). These programs for working parents, although not yet ideal, do not exist in all European countries.

b. General Facts Concerning Employment in French Sciences

A very recent publication summarizes the main sex-dissagregated data on French research (Livre blanc 2002). Here we only present the general trends; section 3 will be devoted to the analysis of the situation of women and men in French research staff.

³ For further information: ANEF, 34 rue du Professeur Martin, F-31100 Toulouse.

Similar to other countries, French research and development is split into the public and private sectors. In 1997 there were approximately the same number of researchers in the civil public (91,800 persons) and in private institutions (78,300 persons) (Bonneau 2000). In public arena are universities (faculty members numbered 49,931 in 1999, see below section 3) and different research institutions, the largest one being the National Center for Scientific Research (CNRS) (11,485 researchers in 2000, see below section 3). These are subject to public regulations. In the private arena are industrial and commercial structures, such as the Atomic Energy Commissariat (CEA).

The scientists in French universities and research institutions are in general civil servants, or state-employees. After a short post-doctoral period, they are hired for permanent positions between age 30 and 35, depending on the discipline. In the last several years, the government has provided incentives for state researchers to join the industrial sector, but this has not produced major effects. Since it is easier to be promoted to the rank of university professor than to that of *directeur de recherche* (research director), it is common to start one's career at CNRS and to end it as a university professor.

Generally speaking, in all professions, geographical mobility is low in France: it is usual for people to keep lifelong personal relationships; it used to be common to work for the same company for one's entire career; it is standard for both the man and the woman in a couple to work. Although mobility in academia is generally praised, in reality it is recommended only when a candidate is being promoted to professor.

3. Recent Figures

Chapter 2 of the European Union ETAN report presents the typical "scissors diagram" showing that women comprise around 50 per cent of the students across Europe (in France, for example, 56 per cent of the total number of students are women); they drop among graduate students, associate professors, and finally professors. In France and other Latin countries, in contrast with Germany and the Netherlands where women are already few at graduate level, the percentage of women remains relatively high at the intermediate level and falls only at professor level.

This kind of "scissors diagram" is not a cohort study, following the same persons during the course of their studies and careers, but rather a snapshot at a given year of the sex percentages at the different levels of the academic ladder. It reflects "the leaky pipeline" effect, a phrase introduced in the mid-1990s that expresses the erosion of women percentage when climbing the ladder. Such an effect is observed throughout Europe: the data for Belgium, France, Germany, the Netherlands, Spain, United Kingdom quoted in Chapter 2 of the ETAN report all express the same trend (for more recent references, see Micali 2000 and the papers by E. Veikkola, Finland; T. Patricio, Portugal; and D. Weis, Belgium, in Colosimo et al. 2001).

It is sometimes enlightening to build relevant indicators from sex-disaggregated statistics. Chapter 8 of European Commission 2000, for example, is devoted to “Gender Statistics in Science: Measuring Inequality.” Table 8.1 indicates the number of men who would have to vacate their positions in order to achieve equal sex distribution among professors in France: for the year 1998, this amounted to 1,576 in physics and chemistry, 1,372 in mathematics, 496 in biology, medicine, and 1,124 in the humanities. This thought experiment merely indicates the scale of the problem (this type of replacement is, of course, preposterous!). Another indicator might be called the “promotion disparity.” In French universities where there are two professorial ranks (*maître de conférences* and professor), one can evidence it from the current distribution of the sexes by rank, which is very discipline dependent. For instance, statistics show that women are more likely to be promoted to the rank of professor in law than in biology: in law currently 51 per cent of the men are professors, in comparison with 25 per cent of women; in biology 38 per cent of the men have achieved this rank, but only 10 per cent of the women, even though women are well represented at the lower level. An indicator quantifying the *better* men promotion is introduced in §3b.

a. University Faculty

We first present French procedures for hiring and promotion, which may help the reader to define the equivalence with the university ranks in other countries.

In France, after having defended his or her Ph.D. (and in some disciplines having carried out one or two years of post-doctoral research), a scientist wishing to become a faculty member applies to become a *maître de conférences* (MdC) at the National Council of Universities (CNU). Once accepted, the person is entitled to be candidate to any of the MdC positions offered by various universities. If successful, the person becomes an MdC.

To become a professor in a French university, the MdC must first defend his or her *habilitation*, a national diploma awarded by a university. This diploma certifies that the person is a highly qualified researcher, displaying an original approach in a scientific domain, an autonomous strategy of scientific research, and the ability to guide young researchers. The “habilitated” candidate then applies to be considered for the position of *professeur* to the National Council of Universities. Once the candidate is approved, he or she may be a candidate to open positions of *professeur* at universities. In law, politics, economy, management, professors must have passed a competitive national examination.

University disciplines in France fall into four main groups: law (and economy), literature (and human sciences), science, and health (health includes medicine – the faculty of which have a specific status – and pharmacy). Statistics are gathered according to these groupings. A more detailed analysis of women’s position in

individual disciplines will be given in §3d. For simplicity, we will discuss only the two academic main rankings, the *maître de conférences* and *professeur*.

Figure 1 presents the total number of MdCs and professors by sex for the four main groups of disciplines (Boukhobza et al. 2000). As can be deduced from these data, science MdCs (men and women) represent 49 per cent of the total MdC staff, science professors (men and women) are 40 per cent of the total number of professors.

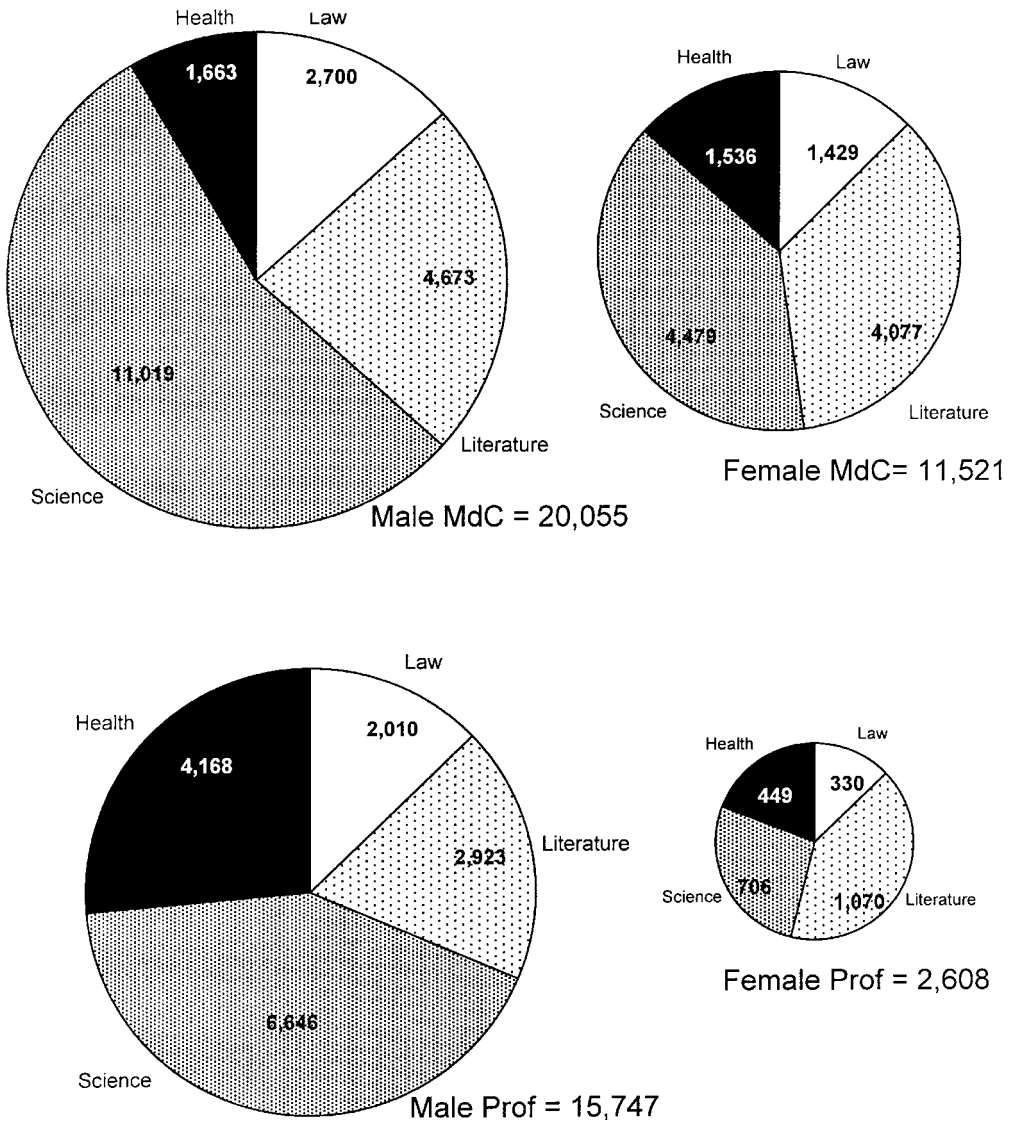


Fig. 1. French faculty: numbers according to gender and rank in the four groups of disciplines.

	Law	Arts and Literature	Science	Health	Total
MdCs	35%	47%	29%	48%	34%
Professors	14%	27%	9.6%	11%	14%

Fig. 2. Percentage of women among French faculty (1999), by rank and main groups of disciplines.

The corresponding women percentages are listed in Figure 2. For MdCs, the lowest percentage of women is in science (29 per cent). Equality between the sexes is nearly obtained for health and literature. For professors, all the percentages of women are much lower than the corresponding ones for MdCs, the lowest being in science (9.6 per cent women). The percentage of women among the professors is also very low for health (11 per cent), although sex equality is nearly obtained for MdCs.

Even though France is a centralized country, the universities retain some autonomy. Hence, it is interesting to compare the representation of women faculty in different universities. For instance in Paris and its neighboring areas, the percentage of female faculty is much above the national average. By contrast, the major universities in the countryside have very low percentages of women, in some places on the order of only 3 per cent of the professors.

As for average age, it should be noticed that it is not much sex-dependent, although women are always slightly younger than men at each rank.

Two conclusions can be drawn from the statistics presented above. First, the pool of qualified women for top positions is large for health and literature but small elsewhere, particularly in science. Second, across the board the percentage of women in the rank of professor is much lower than in the rank of MdC. This means that it is more difficult for a woman than for a man to be promoted (see below).

b. Developments in the Past Twenty Years in the Main Groups of Disciplines

During the past twenty years, the largest increase in the number of MdCs appears in science and the lowest in health. The same pattern is found for professors. Has this increase permitted an increase in the percentage of women? The change in the proportion of women in four *main groups* of disciplines for the rank of MdC and that of professor is given in Figure 3. For MdC, this percentage has remained nearly constant for health and literature and has increased very slightly for science, noticeably in law. For professor, in the case of science and health, the percentage has remained very low, below 10 per cent; for law and literature there has been a slight increase during the past twenty years.

In order to compare the difficulties of attaining promotion for men and women, a ratio can be defined in the following manner: first the ratio of the number of professors to the number of MdCs is calculated separately for men and women, and then the men's ratio is divided by the women's ratio. Figure 4 shows that this final

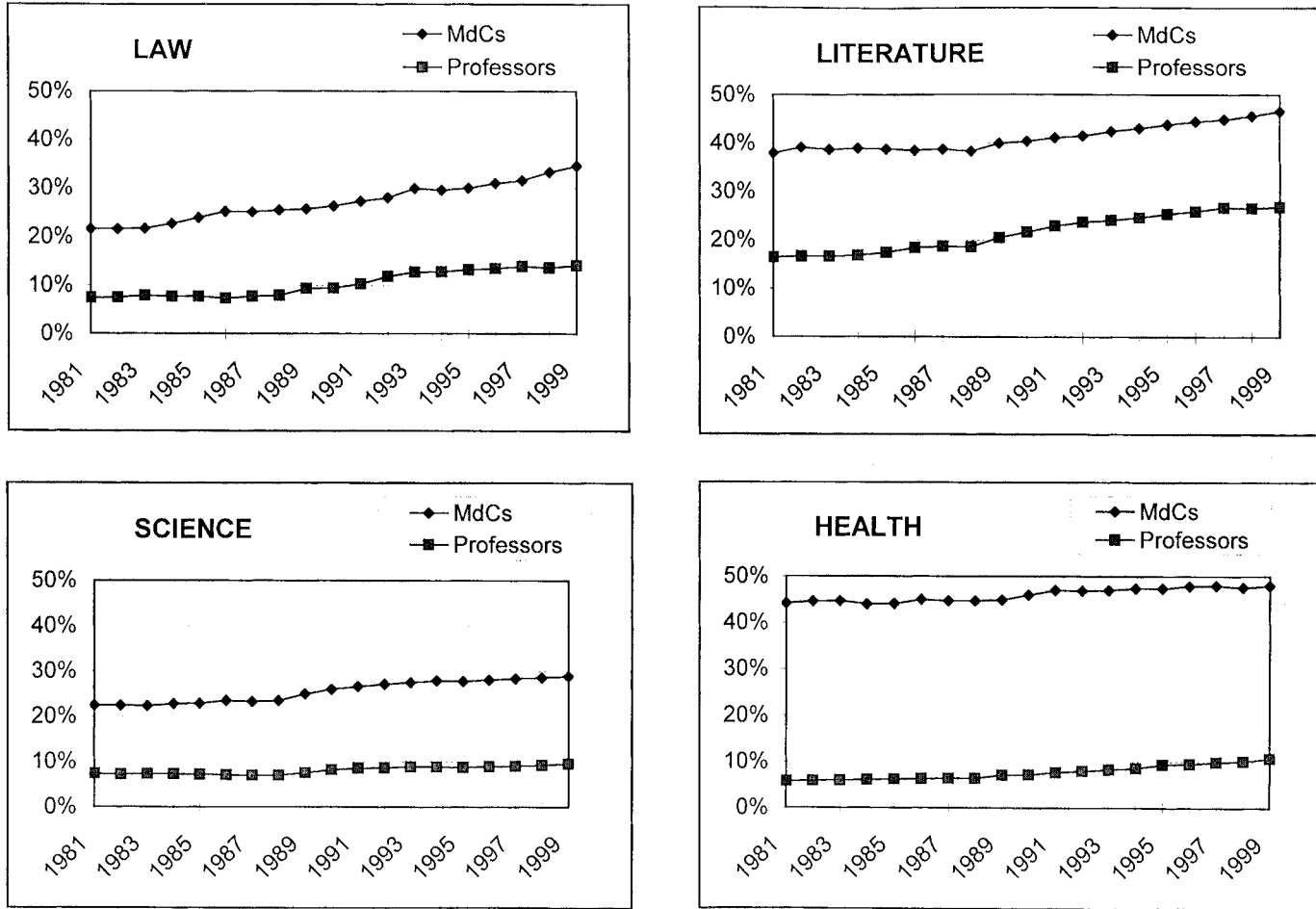


Fig. 3. Change in the percentage of women among MdC and university professors in four groups of disciplines.

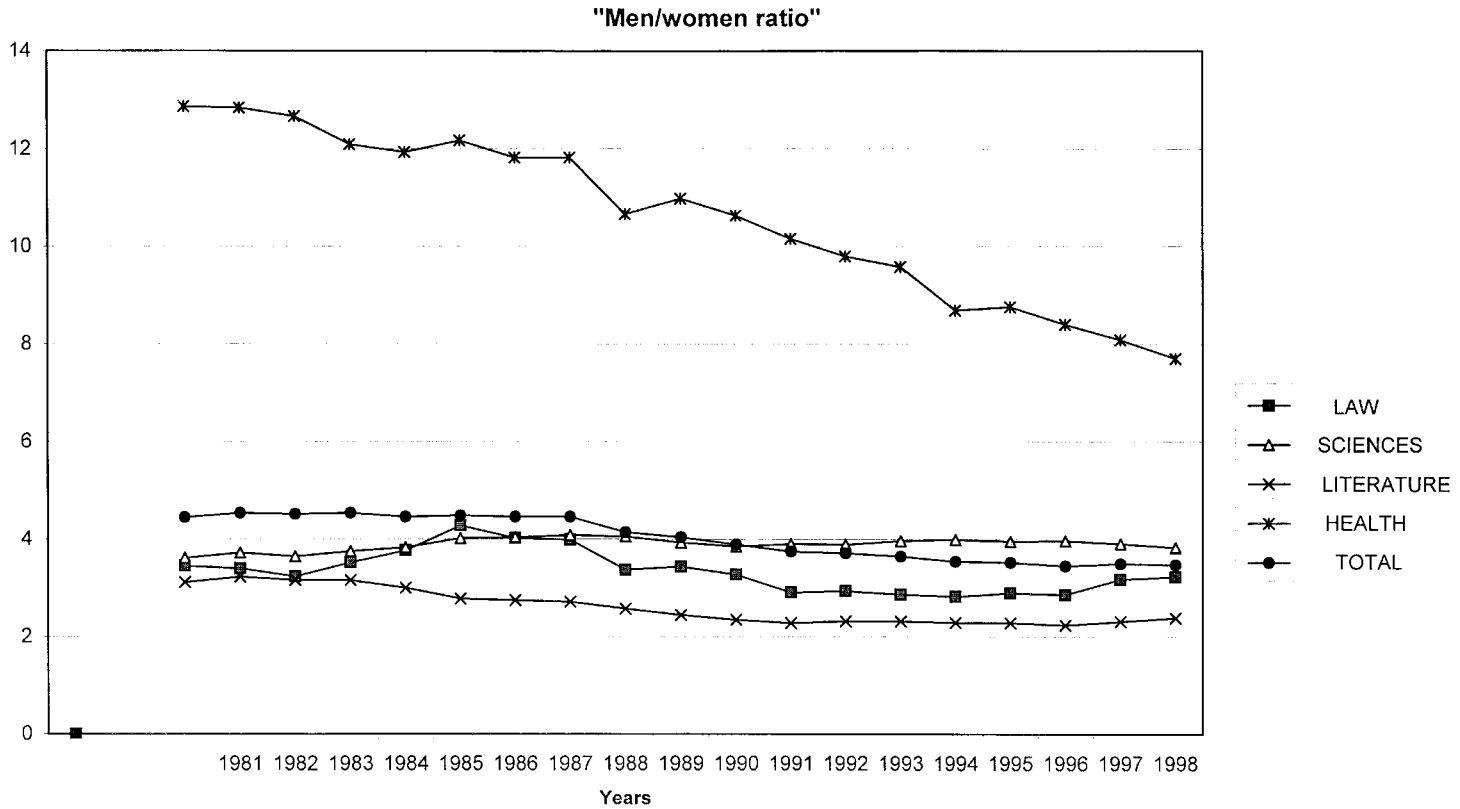


Fig. 4. The chances of promotion for women and men faculty compared. The plotted “men/women ratio” is obtained by the following procedure: first the ratio of the number of professors to the number of MdCs is calculated for men (“men’s ratio”), then for women (“women’s ratio”), and then the men’s ratio is divided by the women’s ratio. The figure evidences that this final ratio (“men/women ratio”) is in general between three and four.

ratio (men/women ratio) is currently approximately three to four in most groups of disciplines. This indicates that it is three or four times more likely for a man to be promoted than for a woman. The likelihood for a woman to be promoted depends on the group of disciplines and is highest for literature and lowest for health.

The evolution of this ratio, presented in Figure 4, shows that except for health, where this particularly high ratio decreased from above 12 to below 8, it has remained fairly constant for the other disciplines. Thus the increase of the number of faculty members has not been favorable to women. The largest absolute increase of faculty members, in science, corresponds to a very small increase of the percentage of women.

c. Research Institutes

There are many state research institutes in France, the largest one being the CNRS (Centre National de la Recherche Scientifique), which covers all disciplines except law. It is interesting to apply the same analysis to the CNRS researchers as for university faculty members. At the CNRS there are two main ranks: the lower rank is *chargé de recherche* (CR), the higher one *directeur de recherche* (DR). They correspond exactly to the academic ranks of M_dC and professor. The disciplines at CNRS are grouped into scientific departments: nuclear and corpuscular physics; physical and mathematical sciences; sciences for engineering; chemical sciences; sciences of the universe; life sciences; human and social sciences. The percentages of women in these departments are given in Figure 5 (the Department of Sciences of Information and Communication Technologies was created very recently).

The analysis for CNRS shows qualitatively the same features as for the universities. Nevertheless, the opportunity for promotion is slightly better for women, as now the men/women ratio is smaller and close to 2/1; i.e. it is “only” two times easier for a man to be promoted than for a woman. It seems that these differences exist for other institutes as well: for example, the Institute for Health and Biological Sciences (INSERM) also evidences a ratio of 2/1. The reason why institutes behave in a different way than universities and permit female scientists to be promoted more easily is not known.

	PNC	SPM	SPI	SC	SdU	SdV	SHS	Total
Ch Rech	24%	22%	23%	37%	30%	46%	46%	37%
Dir Rech	10%	12%	9%	18%	18%	28%	31%	21%

Fig. 5. Percentage of women among researchers at CNRS (31/12/00), by scientific department and rank. The lower rank is that of Chargé de recherche, the upper one that of Director of research. The listed scientific departments are PNC: Nuclear and Corpuscular Physics; SPM: Physical and Mathematical Sciences; SPI: Sciences for Engineering; SC: Chemical Sciences; SdU: Sciences of the Universe; SdV: Life Sciences; SHS: Human and Social Sciences.

d. Gender Differences by Discipline

It is interesting to study the differences within a group of disciplines, as is done in Figure 6. In French universities, at the MdC rank, the percentage of women is higher for language, literature, and pharmacy. The case of science is interesting (for the particular case of physics, see Bussac et al. 1998). For MdCs there is nearly sex equality for biology and biochemistry with 46 per cent of women, but in comparison there are only 17.5 per cent women in mechanics (listed as computer, engineering, energetics), 26 per cent in physics and 35 per cent in chemistry. For professors, the percentage of women is only 14 per cent in biology and biochemistry and 5.5 per cent in mechanics. In other disciplines the percentage of women professors ranges between 8 and 10 per cent. Thus, except in biology and biochemistry, it remains difficult for women to begin a career in science; once in the first academic rank, it is not easy for them to be promoted. When looking at the same analysis by disciplines for the CNRS (Fig. 7), one comes to the same conclusions except that the number of women is greater in the upper rank.

Thus the chances for promotion for men and for women differ according to discipline both in the universities and at the CNRS. However it is not in the disciplines where women are the most numerous in the lowest rank that they have the greatest chance of being promoted, as shown in the universities for biology, biochemistry, and pharmacy, or at the CNRS for chemistry.

e. French Appointment Committees

The university nominations and promotions are decided by the committee *Conseil National des Universités* (CNU), where both academic ranks are represented. For the last few years, efforts have been made to reach a percentage of women representatives corresponding to that of the pool of corresponding faculty voters. Indeed, women are underrepresented among the members elected from the union lists: only the relatively higher percentage of women nominated by the ministry has allowed a better sex balance. This is not true in the other research institution councils, where the ratio of nominated women is significantly lower than that of women voters.

The percentage of women for the MdCs representatives in the CNU appointed in 2000 (Boukhobza et al. 2000) are respectively 44 per cent in law, 48 per cent in literature, and 31 per cent in science. The corresponding figures for the professors' women representatives are respectively 17, 26, and 14 per cent. This has to be compared to the percentage of women in the two academic ranks of the same groups of disciplines (see Fig. 2): it appears that in most disciplines there is a strong correlation between the percentage of women in the faculty and among the representatives of this committee.

For research institutes, taking the example of the CNRS, there exists a committee called *Comité National* that is in charge of appointments and promotions. The representation of women is not very good there; however, it is easier for female

Faculty members in 1999

	PROFESSORS (PR)				MAÎTRES DE CONFERENCES (MdC)				Ratio PR/MdC Men	Ratio PR/MdC Women	Comparison of the Two Ratios
	Men	Women	Total	% Women	Men	Women	Total	% Women			
Law and Political Science	894	209	1103	18.9%	929	657	1586	41.4%	96.2%	31.8%	3.03
Economic Sciences and Management	716	94	810	11.6%	1218	635	1853	34.3%	58.8%	14.8%	3.97
LAW	1610	303	1913	15.8%	2147	1292	3439	37.6%	75.0%	23.5%	3.20
Languages and Literature	1121	537	1658	32.4%	1702	2156	3858	55.9%	65.9%	24.9%	2.64
Human Sciences	1206	373	1579	23.6%	1966	1308	3274	40.0%	61.3%	28.5%	2.15
Interdisciplinary group	267	63	330	19.1%	627	409	1036	39.5%	42.6%	15.4%	2.76
Theology	33	2	35	5.7%	19	5	24	20.8%	173.7%	40.0%	4.34
LITERATURE	2627	975	3602	27.1%	4314	3878	8192	47.3%	60.9%	25.1%	2.42
Mathematics and Computer Science	1446	196	1642	11.9%	2663	1035	3698	28.0%	54.3%	18.9%	2.87
Physics	902	87	989	8.8%	1284	452	1736	26.0%	70.2%	19.2%	3.65
Chemistry	972	119	1091	10.9%	1397	756	2153	35.1%	69.6%	15.7%	4.42
Geosciences	376	32	408	7.8%	589	189	778	24.3%	63.8%	16.9%	3.77
Computer Engineering, Energetics	1624	94	1718	5.5%	3198	678	3876	17.5%	50.8%	13.9%	3.66
Biology et Biochemistry	902	148	1050	14.1%	1527	1302	2829	46.0%	59.1%	11.4%	5.20
SCIENCES	6222	676	6898	9.8%	10658	4412	15070	29.3%	58.4%	15.3%	3.81
Pharmacy	462	147	609	24.1%	482	654	1136	57.6%	95.9%	22.5%	4.26
TOTAL	10921	2101	13022	16.1%	17601	10236	27837	36.8%	62.0%	20.5%	3.02

Fig. 6. Percentage of women among French university staff (1999), by discipline and rank

CNRS Researchers											
Discipline	CR				DR				DR / CR		Ratio
	Women	Men	Total	% W	W	M	Total	% W	M	W	
Mathematics	38	186	224	17.0%	16	97	113	14.2%	0.52	0.42	1.2
Physics	205	717	922	22.2%	93	684	777	12.0%	0.95	0.45	2.1
Chemistry	341	631	972	35.1%	124	585	709	17.5%	0.93	0.36	2.5
Engineering Sciences	154	581	735	21.0%	37	382	419	8.8%	0.66	0.24	2.7
Universe Sciences	182	440	622	29.3%	72	343	415	17.3%	0.78	0.40	2.0
Biosciences	985	1130	2115	46.6%	396	977	1373	28.8%	0.86	0.40	2.2
Human and Social Sciences	606	733	1339	45.3%	225	525	750	30.0%	0.72	0.37	1.9
Total	2511	4418	6929	36.2%	963	3593	4556	21.1%	0.81	0.38	2.1

CR = chargé de recherche (same level as MdC)

DR = directeur de recherche (same level as professor)

The last column gives the men/women ratio, i.e. it evaluates the higher chance of promotion of men.

Fig. 7. Percentage of women among the researchers of CNRS (31/12/00), by discipline and rank.

scientists to be promoted at CNRS than in the university. This shows that there is no obvious correlation between on the one side the appointment and promotion of women, and on the other side the percentage of women present in the committees. More precise studies are planned in the near future.

f. Academic Careers

Defending a Ph.D. is the first step for an academic career, but only one fifth of Ph.D. laureates enter that career (currently such statistics are not broken down by sex). One can only notice that the percentage of women receiving a Ph.D. in science has not increased significantly. This fact helps explain the small number of women staff in disciplines such as mathematics, physics, and mechanics.

As noted in section 3a above, in order to be promoted to the rank of professor, in France one needs first to be approved by the CNU. One notices that the percentage of women approved by the CNU is always smaller than the percentage of women among the *maîtres de conférences*. Many more studies would be necessary to understand why, starting with a large percentage of women as university students, such a small percentage of professors are female.

4. Education

There has been an interest in the scientific and technical education of girls for almost two decades. Several agreements were signed between the Ministry of National Education and the Ministry for Women's Rights. One of the main objectives of the 20 December 1984 agreement was "the improvement of girls' training and professional integration." The main priority of the 14 September 1989 agreement was the need for girls to widen their choice of training to include more industrial training. In these frameworks a considerable number of actions were implemented to push girls to focus on scientific and technical sectors in choosing their careers. In particular a "Prize for Feminine Scientific and Technical Vocation" is awarded each year by the regional deputies of the Ministry of Education and of Women's Rights to each of 600 girls who present their projects the year before they enter higher education. In spite of its rather modest amount (700 Euros), this prize is well publicized in many regions and offers moral support to girls from modest families choosing scientific or technical careers.

As for French higher education in general, the system is dual, i.e., it is split into universities (§a and b) and *Grandes Ecoles* (§c) for engineering, agriculture, business, and administration. These two education systems meet only at the Ph.D. level. Access to top positions in French economy, science, or politics is achieved through the *Grandes Ecoles*, both the scientific ones and those for business or administration. To prepare for the selective exam to enter the *Grandes Ecoles*, students spend two years

in special classes, *classes préparatoires*. In classes preparing for access to business schools, female and male students are present in equal numbers. In the scientific classes, the overall percentage of women is 29 per cent, with around 25 per cent for those based on physics and chemistry, less than 10 per cent in more technological areas. In the classes preparing to become army officers through the school held at Saint-Cyr, the percentage of women increased from 6 per cent in 1997 to 20 per cent in 1999.

a. *Technical Higher Education*

In the Technological Institutes of the Universities (IUT), students receive a two-year education to become technicians. In the secondary domain IUTs, women represent less than 20 per cent of the students. They are less than 10 per cent in electronics, mechanics, computer sciences and mechanical engineering. In the past few years, the sectors with many women (education and social work) have become even more feminine, while the sectors with few (mechanics) have become even more masculine (Broze et al. 2000).

b. *University Students*

Women now represent 56 per cent of university students and 40 per cent of the students preparing Ph.Ds. If the percentage of women students has increased over the last two decades in medicine, where women students are a majority in France, and in biology or chemistry (equal number of women and men up to the fourth university year), it has remained low in mathematics (around 50 per cent in the first 3 years, 20 per cent thereafter) or physics (38 per cent the first 2 university years, 30 per cent thereafter), and very low in engineering. For example, in the electronics, electrical engineering and automatic discipline, at the license level (third year), women represent only 9 per cent of all students, in comparison with 41 per cent for all scientific disciplines (Dupas et al. 2000).

c. *Top-ranked Grandes Ecoles: a Co-Education Failure Story*

In French society, the situation of *Grandes Ecoles* is mythic. Many families dream of having a son enter the *Ecole Polytechnique* (for engineering) or the *Ecole Nationale d'Administration* (for high state administration), but until now very few of them have invested such hopes in their daughters. The *Ecoles*, besides offering privileged conditions of studies, provide a very useful “old boys” network that persists over a lifetime. The best students, in science for example, follow this path, which lead many of them to a non-scientific career. Apart from biology the percentage of women on science tracks in the *Grandes Ecoles* is currently between 15 and 30 per cent, in comparison to 36 per cent of women in science in the universities (a particularly low

percentage is the 4 per cent of women students in the *Ecoles Nationales Supérieures des Arts et Métiers*, the top mechanical engineering school in France, [see Delavault 1997]).

A non-official ranking exists among the *Grandes Ecoles*: for mathematics, physics and chemistry, the *Ecole Normale Supérieure de la rue d'Ulm*, Paris, (ENS) and the *Ecole Polytechnique* ("X") are considered the top ones. The students graduating from ENS mainly do research or teach at the university level; those graduating from X enter industry and top state technical administration (*Corps de l'Etat*), but a non-negligible fraction of them defend a Ph.D. and continue in research. These renowned schools were both founded two hundred years ago.

As for women students, *Ecole Normale Supérieure de Jeunes Filles* (the corresponding women's school to *Ecole Normale Supérieure de la rue d'Ulm*) was founded in 1881 to educate future women teachers for the girls' public secondary schools (see §1a). It became co-educational in 1986 by merging into *Ecole Normale Supérieure de la rue d'Ulm*.

The alumnae of *Ecole Normale Supérieure de Jeunes Filles* who studied there in the mid-60s are now mostly university professors or research directors at National Center for Scientific Research. At that time, the selective entrance examinations for *Ecole Normale Supérieure de la rue d'Ulm* (men) and *Ecole Normale Supérieure de Jeunes Filles* (women) were distinct, with different rankings, even though some courses were the same. The number of positions in science for a given year were similar in the two schools: out of the total for these two schools approximately 40 per cent of the positions were to be filled by women. Although not formulated this way, it represented a kind of "quota," as this female percentage was much higher than in the candidates' pool.

Since the decision in 1986 to go co-ed, the number of girls who passed the entrance examination for the *Ecole Normale Supérieure de la rue d'Ulm* dropped dramatically for mathematics. In physics the percentage of female students is now approximately 15 per cent, i.e., it corresponds almost exactly to the proportion of girls in the classes preparing for the selective examination (see Adda 1993–1996, Delon 1995, Ferrand et al. 1999). This new situation is clearly dramatic in mathematics, but also problematic in physics where women were overrepresented before co-education. Yet the women who went through such studies have pursued normal careers and have held regular scientific jobs. This is an example of a coeducational decision that did not reach its target: indeed, a generation of women researchers is lost. Previously, when women students entered *Ecole Normale Supérieure de Jeunes Filles*, their ambition was typically to teach in a secondary school, until their professors convinced a goodly number of them that research and teaching at the university level would be an exciting job within their reach.

Note that it is only about ten years after the decision of co-education of the *Ecoles Normales Supérieures* in the mid-1980s, that analyses and discussions on the new situation of women there really began. Up to now, the only measure, taken in 2001,

has been a memorandum of the directors of the scientific *Ecoles Normales Supérieures* to the correctors of the written (anonymous) problems for the selective entrance examination. They are asked particularly to evaluate the in-depth answers to the questions: several preliminary studies evidenced that girls have a tendency to answer questions more completely, losing time and marks as compared to boys, who follow a better strategy.

Whatever the difficulties resulting from co-education in this particular case, there is no discussion in France on returning to separate education for women and men students, in the context of universality of rights that prevails in France (see §1.c above): the law on parity in politics (Picq 2002), voted in 1999, required a modification of the French constitution and quotas are in general not accepted. It should be noted that in Scandinavian countries, where affirmative actions have been taken in particular to create women professors positions, not all were successful: one was reduced by the national parliament (Sweden), another is being brought to the European court (Norway).

Ecole Polytechnique, perhaps because of its military status, was among the last engineering schools to accept women, in 1972. Its women students indeed complete their military service like their male colleagues, follow the same curriculum, become state engineers or civil engineers, and get approximately the same salary as their male colleagues at the beginning of their career. They are privileged in the French system, since the women graduating from less prestigious schools have more handicaps. The very first year that women students were accepted, a woman was ranked first (this happened for the second time in 1995). Since then, the number of women entering *Ecole Polytechnique* has slowly increased. It jumped in 1994 and 1995, when it exceeded 50 women students (out of 400) but unfortunately has leveled out to around 55 per year since.

d. Engineering Grandes Ecoles

The first French engineering school to admit girls was *Ecole Nationale Supérieure de Chimie* de Paris at the end of the nineteenth century. In 1925 a women-only engineering school, the *Ecole Polytechnique Féminine of Sceaux*, was founded. It went co-educational just before its fiftieth anniversary; women now amount only to 40 per cent of its students. One of the most renowned French Engineering schools, *Ecole Centrale des Arts et Manufactures*, admitted its first woman student in 1920, that is, 52 years before *Ecole Polytechnique*.

The surveys completed by the National Council of French Engineers and Scientists (CNISF) include gender categories, and the particular situation of French women engineers has been analyzed by the French association of women engineers. In 1995, women received 23 per cent of the engineering degrees; 13 per cent of active French engineers were women, they are much younger on the average than their male colleagues because their arrival in large numbers in the job is recent: the

average age of active women engineers is 30, to be compared with 41 years for men engineers. The proportion of women engineers differs according to the sector: women are over-represented in teaching, research and development, and under-represented in civil engineering and construction. The situation is rather similar for both sexes in electricity and electronics, sectors that occupy 7 per cent of the total of female engineers and 9 per cent of their male counterparts.

5. Recent Developments (1999–2001)

Recent developments concerning women in science and engineering are related not only to the general French political situation, but also to the importance that the European Union has placed on this issue since 1998.

a. Politics

The issue of political *parité* has raised general awareness about the situation of women in top positions. Following the recommendations of A.-M. Colmou (Colmou 1999), a “steering committee for the equal access of women and men to the top positions of French civil services” was established for five years by the Ministry of Civil Service in November 2000. This committee is to oversee equity issues in general, that will also concern university teaching staff and the scientists of the state research institutions.

b. Research Institutions / Scientific Education of Women

In February 2000, the minister for Employment and Solidarity, the minister of National Education, Research and Technology, the minister of Agriculture and Fishing, the deputy minister in charge of Primary and Secondary Education and the junior minister for Women’s Rights and Profession Training signed a “Convention” for the Promotion of Equal Opportunities for girls and boys at school, and for men and women in continuing education. This revitalizes and widens the scope of the previous agreements (1984 and 1989).

In the same spirit, a conference named “Sciences and Technology: Why (Not) Girls?” was convened in October 2000 by the Minister of Research (ASTS 2001). Its aim was to induce more research to understand and improve the present situation for women in science and to raise awareness concerning these issues especially among educators. Different workshops questioned the place of girls in science education, the way science is taught, the requirements of companies for scientific education and for female staff. In addition to attempting to convince more girls to choose scientific academic careers, the benefit of orienting them towards scientific industrial

professions and the creation of start-up companies by women were also stressed. This in turn creates the need to change the image of private companies and more generally of the industrial environment among young people and their educators. One cause for the low proportion of girls in scientific education is the lack of positive role models.

In his speech, the Minister of Research proposed five practical types of actions, that he confirmed in March 2001:

- improving the information and orientation towards scientific and technical studies, particularly for girls, through programs in primary and secondary schools (in conjunction with the ministry of National Education);
- awarding more Ph.D. scholarships to female students. At the moment, the percentage of women benefiting from such funding roughly corresponds to the women students' pool, except in social and human sciences where the situation is unfavorable to women (Jolion 2002). A positive action would thus be to encourage women through scholarships in disciplines where they are now too few;
- improving the relative representation of women and men in research recruitment and promotion committees;
- favoring the creation of innovative start-up companies by women;
- boosting the former campaign "1000 researchers, 1000 classes," in which a scientist collaborates with pupils from secondary schools in a common project. The idea is to send as many women as men into the schools in efforts to provide female role models.

In the Ministry of Research, a "Mission for Gender Equality in Science and Technology" was created in 2001 and one of the authors of the present paper (F.C.-L.) was its first director. Its aim is to initiate programs proposed by the minister to assess the gender relevance in any new proposals and politics of the ministry. More precisely, the financial funding for 2001–2002, with the help of the European Union is around one million Euros corresponding in particular to

- support to national colloquia on gender equality in sciences
- founding of scientific prizes for women
- initiating research on gender in biology and the history of science
- support for publication and translation of books on the topic
- founding positions for foreign researchers in gender studies
- favoring networks for gender studies

As for CNRS, several events related to Women and Science have taken place since the beginning of 2000. The most important one is the creation of the committee "Disciplines, professions, careers and gender: the place of women at CNRS" in March 2001, presided by the general director of CNRS, Dr. Geneviève Berger. A first training, open to all researchers, on practical gender issues will take place in November 2002.

c. Universities

Since 1997, the Directorate for Higher Education at the Ministry of Education has provided permanent support for the problems related to the situation of women students in science and for those of women in academia. Two people are currently in charge of these questions. For a better understanding of the situation and its origins, a statistical and sociological report on the place of women in French universities was ordered by the Directorate. It was issued in March 2000 and has been widely diffused (400 copies) (Boukhobza et al. 2000, Delavault et al. 2002). This document has had a large impact: The National Council on Higher Education and Research (CNESER) asked for a presentation of these findings (October 2000) and has decided to establish a working group on the situation of women in universities aimed at proposing practical measures for improvement. This group is now analyzing the place of women in graduate studies. In addition to these measures, since 2001 universities have been invited to propose women-friendly programs, which receive special funds for their realization.

d. Associations

Several women's associations already existed, related in some way to the issue of women and science: *Association Française des Femmes Diplômées des Universités* (French Association of University Women),⁴ *Association Française des Femmes Ingénieurs* (French Association of Women Engineers),⁵ *Association Femmes et Mathématiques* (Women and Mathematics).⁶ In December 2000 the association *Femmes et Sciences* (Women and Science)⁷ was created, the objectives of which are both to promote scientific education for girls and to improve the situation of women scientists. Its first public action in November 2001 was a colloquium "Women in scientific and technical professions."⁷ The association *Pour la parité dans les métiers scientifiques et techniques* (For parity in scientific and technical professions), founded in 2002 in Grenoble, pursues similar objectives.⁸ There is currently a strong demand all over France for interventions on the issue of women and science.

Conclusion

This short paper does not claim to describe fully the complex situation of women scientists in France. Yet it tries to give a cursory outline of the situation: a rather

⁴ <http://www.int-evry.fr/affdu>.

⁵ AFFI, CNISE, 7 rue Lammenais F-75008 Paris.

⁶ <http://www.desargues.univ-lyon1.fr/home/fem/fem.html>.

⁷ http://www.int-evry.fr/femmes_et_sciences/ The colloquium proceedings can be found there.

⁸ http://isnwww.in2p3.fr/atlas/fairouz/parite/parite_sciences.html.

favorable social system has created the possibility for women to work, in particular in science. Quite a number of women educated in women-only *Ecoles Normales Supérieures* led to the tradition of the presence of women scientists in universities and research institutes. Since the decision of co-education in these elite schools, the number of women students has dropped, but women can now be found on other educational paths, including engineering schools.

In recent years, following concern about the insufficient representation of women in French politics and in conjunction with the many European union initiatives for women in science, new attention has been brought to the issue of women in science both at the governmental and institutional levels. Hopefully these efforts will result in concrete actions that will permit men and women to contribute equally to the science of tomorrow.

Acknowledgements

Claudine Hermann would like to thank Huguette Delavault who taught her so much in the field of Women and Science and the members of the European Union Helsinki Group on Women and Science with whom she has been serving as one of the two French representatives since 1999. Françoise Cyrot-Lackmann extends warm thanks to the team who worked with her (2001–2002) when she served as the Director of the Mission for Gender Equality in Science and Technology in the French Ministry of Research. We thank J. Peiffer and H. Rouch, who wrote section 1.c on gender studies. We are grateful to H. Delavault for providing us a great deal of original data and to M. Lynch for a careful reading of the manuscript.

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