— SCIENCE UNDER CONTROL —
The French Academy of Sciences 1795–1914

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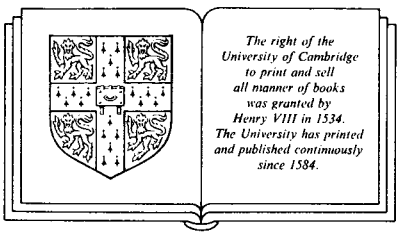

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INTRODUCTION

> The National Institute will be in a way the epitome of the world of learning, the representative body of the republic of letters, the honorable goal of all the ambitions of science and of talent, the most magnificent recompense of great effort and of outstanding success.
>
> (Daunou, Report to the Convention, 19 October 1795.)

> I have no hesitation in saying, after having recently seen the Academy of Sciences at its weekly labours, that it is the noblest and most effective institution that ever was organised for the promotion of science.
>
> (Sir David Brewster, *Report of 20th meeting of the British Association*, Edinburgh, 1850, p. xli.)

> I was not mistaken with respect to the Academy of Sciences and the other academies founded on the same basis; they are bodies depending on the government and functioning by its orders... For thirty years not a single cog in the wheels of the Academy of Sciences has been worn out; it is the same system in operation; it turns around the same axis; the handle of the machine has often been changed but never the spring; it has outlived the downfall of all its masters. It has always... made the sounds required of it, stifling those which did not please it, raising up to the highest place an individual favoured by the government, even if he is an idiot.
>
> (F. V. Raspail, *Nouveau système de chimie organique*, 2nd edn, 1838, vol. 1, pp. xxvi–xxvii.)

The growth of science over the last few centuries has been compared by some critics to the opening of Pandora's box. But if some of the *applications* of science have been harmful, science itself as knowledge has been more generally recognised as good. Science has produced many wonders, but its very success has introduced problems. Science has been particularly successful in exploring new knowledge rather than, like the humanities, re-examining human experience from different standpoints. But, given this increased understanding of the natural world, should it be left, as formerly in Britain, to the private individual to pursue as a hobby or was it important enough to be a matter of government concern? In France from early times the government wanted to be involved and for several reasons. One was obviously that this new knowledge might be of practical use to the Crown. Another might have been that uncontrolled knowledge of nature could constitute a threat to the established order. A third and more positive reason was that Louis XIV wanted to be seen as the patron

of learning. As time went on, the benefits to the modern state of the patronage of science became more evident. For example, by the time of the French Revolution of 1789, men of science were able to apply their expertise to national defence. Perhaps science had almost come of age but not without imposing the burden of new responsibilities on its practitioners.

The title of this book refers both to governmental control of the official French body of science, known as the Academy of Sciences for most of our period, and the control, by the Academy, of scientific production by registration and judgement. If the author had been concerned exclusively with relations between the government and the Academy, the book might well have been entitled 'The Academy under control'. However, although this is a part of our concern, we have a particular interest in the control exercised by the Academy over science. We have, therefore, accepted a dual task. The question of the *application* of science to control the natural world has only been dealt with fairly superficially. Although the Academy included some technology among its concerns, this was not its principal purpose.

'Control' is a term capable of a range of different interpretations from the most authoritarian to the more liberal, and certainly government control in any one country showed considerable change and development in the early modern period. Generally speaking, early reliance on command and restraint gave way to more indirect methods of control.[1] So in society generally there was a development of chains of interdependence, binding individuals to each other, which was to affect the emergent scientific community. For men capable of restraining their short-term impulses in the pursuit of long-term goals, changes in society and in the development of the organisation of the scientific enterprise offered social rewards in terms of status or power and, at a comparatively early date in France, in terms of income and careers.

In the eighteenth century France was ruled by an absolute monarchy. With the French Revolution, despite its cry of 'liberty', came the Terror (1793–4) with its draconian measures including price control (maximum price legislation), conscription and mass executions. Under Bonaparte political control was in some ways tightened even more, with the introduction of strict censorship of the press, to give only one example. As regards science, it will be for the reader to decide whether government control of the Academy – partly political and partly financial – should be considered as repressive. Certainly many nineteenth-century critics outside France would have interpreted the very existence of government regulations as repressive.[2] Yet, with a few exceptions, the system was much more liberal in practice than that which had operated under the *ancien régime*. Also one should not think of government involvement as

[1] Norbert Elias, 'Scientific establishments', *Sociology of the sciences*, **6** (1982), 3–69 (p. 10).

[2] 'The regulations of the French Institute would appear ... revolting and injurious to the feelings of an Englishman'. G. Moll, *On the alleged decline of science in England*, 1831, p. 24.

necessarily one-sided. The Academy or, strictly speaking, the First Class of the Institute in the period 1795–1815, received from the government a special authority, which it welcomed, and, as a government-sponsored agency, its activities acquired a valuable legitimation.[3] Any control that the government exercised over science was long-term, while the Academy's control over science was both long-term and short-term. Thus the government laid down general guidelines and demanded annual reports but it was the Academy which, week by week, decided the merits of particular scientific contributions.

The control exercised by the Academy over science depended very much more on a system of encouragement than of restraint. There was no censorship as such, but rather a subtle combination of recognition and reward, which no ambitious scientist could afford to ignore. Because of extreme centralisation and the prestige associated with government-sponsored organisations in France, nearly all major scientific research had to be directed to the Academy if it was to make its mark. Thus, although the Academy never had a legal monopoly over science, even high-level science, in many ways it had a virtual monopoly in practice. There was no alternative national forum of comparable importance. It was the Academy which decided whether a piece of work was to be considered as real science, quite apart from the question of whether it was good science. And although a lot of science went on outside the Academy, the latter was always enough of a magnet to attract to it most of the best science done in the nineteenth century in France and, sometimes, in other parts of the world. And, for a part of our period, much of the best science in the world was done in France. Although it is the early nineteenth century, which is sometimes referred to as the 'golden age' of French science,[4] the third quarter of the century was the period of the greatest work of Louis Pasteur. At the very end of the century the new science of radioactivity began in France and, with the work of Henri Poincaré (1854–1912) and some of his contemporaries in the Academy of Sciences, mathematics in France began to recover some of the distinction it had earlier enjoyed.

This study of the Paris Academy of Sciences is intended firstly to provide some understanding of a key institution; one might almost say that it is work of demystification, pulling aside the veil, which has obscured the activities of a major scientific society of international repute. If, as has been claimed, the Academy was (among other things) a stage, we need to know something of what went on behind the scenes. When Marcellin Berthelot, as secretary of the Academy, was asked by a newspaper to say something about activities within the Academy on the occasion of the centenary of the Institute, he replied deliberately in the vaguest generalities, saying:

[3] C. C. Gillispie, *Science and polity in France at the end of the ancien regime*, Princeton, N.J., 1980, p. 54

[4] See e.g. Robert Fox and George Weisz, *The organisation of science and technology in France, 1808–1914*, Cambridge, 1980, pp. 26, 33.

> You see, therefore, that in my opinion a member of the Academy of Sciences... should behave with discretion and say nothing about his life as an Academician.[5]

Any personal clashes should obviously be hushed up as inimical to the image of a purely rational science. In connection with the elections to membership, there were regular frank discussions of the relative merits of candidates and their work, and understandably, these had to be held in private. To learn about all this it has been necessary to gain access to confidential minutes and study a large volume of surviving manuscript notes. Although French archives can be very rich, the Academy archives – despite intermittent valiant efforts of different generations of archivists – constitute a complex web with many holes; a visiting scholar, who recently tried to describe them,[6] only succeeded in revealing some strands of the web. There is no catalogue to the archives such as exists, for example, in the Royal Society of London and photo-copying of manuscripts is not permitted. Some introduction to the Academy or general survey of its functioning is, therefore, all the more desirable.

British and North American scholars, knowing the pattern of scientific organisation in their own countries, can sometimes be misled by making assumptions about the French, who follow a very different tradition. Some science historians have in particular failed to understand why, when a genius presented himself for election, he was not always immediately successful. The relationship between scientists and government in France has been another mystery. Finally the relation of the Academy of Sciences to the Institute of France has proved a stumbling block. It is worth understanding to what extent the actions of the scientists in this official body were constricted by institutional association with bodies representing other leading French intellectuals. The reader might be surprised how many writers in the English language, including several reputable historians and scientists, refer to the Academy of Sciences as the Académie Française, which is of course the name of a sister academy concerned with French language and literature.

But the purpose of demystification is only a beginning. One may hope to do more than simply transcribe French documentary sources or explain the administration of French higher education. The Paris Academy of Sciences is of major importance even to those with no interest in France because it was an arena for the working out of the place of the scientist in modern society. It established many precedents of world-wide influence in the performance of

[5] M. Berthelot, *Science et morale*, 1897, p. 207. For an even more extreme example of secrecy, see a letter from the secretary Flourens to Libri: 'Si il s'agit de l'Académie... il me semble que tout discussion autant que possible, n'y doit pas laisser de traces.' Bibliothèque Nationale, N.A.F. 3269, f.334. The question of the admission of the public to ordinary meetings of the Academy is discussed in Chapter 10, Section 7.

[6] E. Stewart Saunders, 'The Archives of the Académie des Sciences', *French Historical Studies*, **10** (1977–8), 696–702.

research, its publication and its rewards. We need to understand the circumstances in which various procedures were evolved by the Academy to meet the needs of science and the state.

We should not forget that the Academy contained many of the most eminent scientists of the nineteenth century, who will be introduced in succeeding pages. In addition distinguished scientists from other countries were elected as corresponding members or foreign associates. A study of the Academy seems, therefore, at first sight to be purely the study of an elite. But if membership of the Academy represented the peak of achievement in French science, it should also be appreciated that scientists at all levels were affected by its deliberations and publications. It will be argued that, through the Academy, one may gain a better understanding of the activities and aspirations of a whole scientific community.

The Academy also presented an image of science to the general public. At its annual public meetings it was able to justify itself in terms of national and economic goals. Some consideration of the public image of science, or at least of the image that the Academy wished to project, may be not the least rewarding aspect to emerge from this study. This body represented 'official science' and thus constituted an easy target to attack by those critical of government policy. Yet in periods of rapid political change in the nineteenth century the Academy provided a certain stability and continuity lacking in government. Its direct power was limited but it had enormous influence, something which has never been explored. The present study is, therefore, a first attempt to understand it. At some later date a large research grant might fund a team of scholars to provide an exhaustive multi-volume study. For the present, a more selective and imperfect study may go some way to filling an important gap.

In a way a study of the Academy over rather more than a century is such a vast enterprise with such wide ramifications that no two scholars working independently would be likely to tell exactly the same story. Nevertheless, the author has made a conscious attempt to provide a balanced account. He has tried to take into consideration all of the many sciences represented in the Academy, as well as several which were not officially recognised. (On the other hand considerations of space have precluded the possibility of a detailed treatment of any one science. For such detailed studies of the science content the reader must look elsewhere). The author has tried to balance the perspective of the official representatives of the Academy with the viewpoint of would-be scientists who were rebuffed by that official body.

As an independent researcher, the author has been free to complement his initial position of sympathy for many of the aims of the Academy with some fundamental criticisms of its actual working. Everyone who knows something about French science has probably heard stories about the Academy of Sciences. But a study of the Academy must go beyond the anecdote and the *bon mot*. From the outset it is important to avoid two extreme portrayals of the institution, that have developed in different circles, virtual caricatures, which contradict each

other but which, nevertheless, seem to be taken as accurate representations within the respective groups in which they circulate.

The first caricature has developed through uncritical admiration of the Academy, its members and all its works. Given the distinguished membership of the Academy, it has been all too easy for some to assume that the institution embodied everything that was best in French science. This is the approach taken in the past by many Academicians themselves. When called upon to make some incursion into history, they have felt that it would be an act of disloyalty to venture any criticism of the institution which had honoured them with membership. It has been a generally agreeable custom to celebrate anniversaries and centenaries with congratulations and pious platitudes rather than to dig deeper and sometimes ask embarrassing questions about the weaker aspects of the Academy, which were as real as its undoubted strengths.

But in avoiding the caricature of the Academy as the hero, we should not go to the opposite extreme and view the Academy as a villain or a fool. Knowing some weaknesses within the Academy before the 1975 reforms,[7] it is only too easy to project this back into the previous century. But the historian should beware of reading the present into the past. One example of this mistake is the branding of its entire membership as superannuated *savants*. But, if it was true until the recent reform that the majority of members of the Academy were scientists at the end of their active careers, it was not true in the early or mid-nineteenth century. It would, therefore, be an even bigger mistake to dismiss the Academy as irrelevant to the main stream of science than it would be to assume that it represented the whole of French scientific activity. Yet it was at the centre of that activity for most of the period covered by the book.

One must certainly not overlook the existence of other important institutions in nineteenth-century France. Indeed, the history of the Academy overlaps with that of several institutions of higher education and it will be necessary to mention these as a background to the Academy. If one is interested in mathematics and physical science, it is natural that one should look at the Ecole Polytechnique, founded about the same time as the National Institute. If, on the other hand, one is interested in the biological sciences, the obvious institution to consider is the newly reorganised Muséum d'Histoire Naturelle. There are others, who view nineteenth-century French science and technology through the perspective of the Ecole Normale Supérieure, the Faculties of Science, the Ecole des Mines, the Ecole des Ponts et Chaussées, the Conservatoire des Arts et Métiers, and so on. All these are important institutions in their own way, but each only relates to a limited aspect of science or technology. The Academy related (or attempted to relate) to the *whole* of science as well as to many areas of technology. For most of the scientific community its proceedings were a matter of constant interest and this applies to the provinces as well as those living in Paris, where the pace of life was quicker and the competition stronger.

[7] See e.g., *C.R.*, *280* (1975), *Vie Académique*, 21–3, also A.S., Dossier générale, No. 39.

The Academy was unique as the central national agency for defining, reporting, rewarding and generally controlling science. All of these aspects will be discussed in the course of the book. It has been remarked that 'in pre-professional sciences, prestige and authority were personal possessions, which could not readily be reproduced'.[8] In our story that prestige and authority is held by the Academy. Readers may conclude that the Academy effectively constituted a monopoly, which may not have been entirely to the benefit of science.

But was it appropriate in the nineteenth century to have a single body concerned with the whole of science? This might have been acceptable in the seventeenth century, but surely by 1800 science had become more specialised? The reason why all branches of science were united in one Academy was both historical and ideological. It was a fact of history that the different branches of science had been included in the Royal Academy of Sciences of the *ancien régime*. Despite the many faults that had been found at the time of the Revolution with that institution – that it was under royal patronage, that it was an elitist Academy, that it encouraged inequality of rank, and so forth – the association of different sciences together did not offend republican principles. On the contrary, the spirit of the *Encyclopédie* encouraged the bringing together of different branches of knowledge into a single institution. In his unpublished *Fragment of the New Atlantis* (1793),[9] Condorcet wrote:

> One could still fear the kind of rivalry which reigns between the sciences. It is in the interests of truth that they all combine, because there is not one among them that is not related to all the other parts of the scientific system by a more or less immediate dependence.[10]

Condorcet not only felt that rivalry between sciences was bad but, more positively, that co-operation was good. The First Class of the Institute encouraged collaboration without eliminating a healthy competitive spirit between the different sections.

It is perhaps unprofitable to speculate how another model of doing science, based on independent scientific societies, each representing a different specialism, would have fared in post-revolutionary France. Probably some subjects, such as the new science of chemistry, would have flourished, and physics might still have made important advances, for example in optics and the study of heat. Yet, in independent societies, these sciences would not have been able to inform each other. Also societies representing some of the weaker sciences might well have

[8] Richard Whitley, 'Changes in the social and intellectual organisation of the sciences', *Sociology of the sciences*, (1977), 147.

[9] The context is obviously the work of Francis Bacon, which had been a source of inspiration for the foundation of the Royal Society.

[10] 'Fragment of the New Atlantis or Combined Efforts of the Human Species for the Advancement of Science', in *Condorcet: selected writings*, ed. Keith M. Baker, Indianapolis, 1976, p. 190.

collapsed or withered away. Also there would not have been the same opportunity for new sciences, such as physiology, statistics and bacteriology, to emerge within the interstices of the Academy. The main objection against placing all the sciences together is that it may have discouraged specialised studies, but this is refuted by the actual history of the Academy. The main criticism that we can accept is that by bringing all the sciences into one body, it was necessary to restrict severely the representation of each science in order that the total number of members should not be too great to form a manageable single forum for science. Increasingly, therefore, throughout the nineteenth century there was need for other societies reflecting particular specialisms. Fortunately, although the existence of the Academy may have had an inhibiting effect on the growth of specialised societies, it did not preclude their existence.

Fourcroy, in a burst of revolutionary rhetoric in December 1793, had railed against 'gothic universities and aristocratic academies',[11] but universities are not necessarily 'gothic' nor are academies necessarily 'aristocratic', both adjectives of course being highly pejorative in the revolutionary context. Indeed, there is now general agreement that contemporary science owes much to the reformed or newly-founded universities of the nineteenth century, incorporating, for example, what the Germans called *Forschung* or research.[12] Might modern science not also owe something to reformed academies of the nineteenth century, notably the French Academy of Sciences, which provided many precedents for the financial support of research and its publication as well as for the judgement of merit and the career advancement of scientists?

Up to the present, little detailed research has been done on the nineteenth-century Academy. In so far as it has been referred to at all, it has often been to suggest that it was excessively bureaucratic[13] or at least not as important as the eighteenth-century Academy.[14] Taking the last point, the Academy was arguably even more important in the nineteenth century in one respect than in the eighteenth century in that it claimed to represent the whole of France and not simply Paris. Although in the eighteenth century the Paris Academy had been the most eminent of the science academies in France, the Montpellier Academy, sometimes regarded as an offshoot, had been quite distinguished and the Dijon Academy had been of more than local importance, not to mention the

[11] 'Rapport et project de décret sur l'enseignement libre des sciences et des arts', *Procès verbaux du comité d'instruction publique de la Convention*, ed. J. Guillaume (6 vols, 1891–1957), vol. 3, p. 97.

[12] See e.g. Joseph Ben-David, *The scientist's role in society*, Englewood Cliffs, N.J., 1971, chap. 7.

[13] In an article summarising the work of Ben-David on the organisation of science, Roy Porter writes: 'The Académie...des Sciences...languished as an engine of scientific innovation during the nineteenth century through administrative ossification and over-centralisation.' See Robert C. Olby *et al.* (eds), *Companion to the history of modern science*, 1989, p. 37.

[14] Roger Hahn, *The anatomy of a scientific institution. The Paris Academy of Sciences, 1666–1803*, Berkeley, Cal., 1971.

academies at Bordeaux, and elsewhere.[15] Although some of these provincial academies continued into the nineteenth century, it was only as a shadow of their former glory.[16] In the nineteenth century Paris dominated, being even more of a magnet for ambitious provincials, whether they were looking for a career in journalism, politics, art or science.

In modern times many people tend to think of universities as the most productive location for scientific research. But academies are arguably just as good as universities for producing research, as in many countries they had a better record in effective research until the twentieth century. For *reporting* research, academies are superior. Where they seem to be inferior is in transmitting information and skills to the next generation, since they do not normally include a formal class of membership committed to learning from senior members.[17] But we must not think of academies as being without an appreciative audience. The Academy had at least three audiences, none of which were necessarily passive: those present in the public seats at ordinary meetings, those reading its weekly journal, the *Comptes rendus*, and those attending the annual public meetings. The first two categories contained a fair proportion of scientists aspiring to recognition of their own work, either young men hoping one day to join the elite, or more senior figures, who may already have distinguished themselves in a prize competition and might well be candidates at the next election in their speciality.

Probably the most important and most numerous audience was that which read the *Comptes rendus*. They read it regularly and eagerly to keep up with the latest scientific research, and in doing so they acquired a view of what science was and how it should be pursued and reported. Thus, although lacking the discipline of formal attachment, they nevertheless acquired subconsciously a general view of science, its leading French practitioners and its fashions as well as a more detailed knowledge of their own speciality. What was reported in the Academy could well inspire them to undertake some new research, or perhaps encourage them to approach their current research in a different way.

Finally we might consider the value of the Academy to its members. For modern scientists the necessity of institutional support is well understood. For French *savants* after the Revolution there were several additional reasons for valuing the opportunity of membership of a National Institute. In the first place it offered protection; in the revolutionary period security was not something that intellectuals could take for granted. Secondly, it provided recognition, recognition both of the value of their studies and also, more personally, of the

[15] Daniel Roche, *Le siècle des lumières en province. Académies et académiciens provinciaux*, 1680–1789, 2 vols, 1978.

[16] Francisque Bouillier, *L'Institut et les Académies de province*, 1879.

[17] A possible exception is the Paris Royal Academy of Sciences, which had a rank, originally labelled *élève* (student).

value of the work of individual members. But apart from these considerations, which were particularly pertinent in the final years of the eighteenth century in France, there were also social reasons of more universal validity why senior men of science would appreciate the existence of a national body of science. Most scientists need an audience; they need colleagues, with whom they can discuss their ideas. Colleagues may be required as collaborators, but they are most important for the moral support they can provide and, occasionally, to offer informed criticism. When the Royal Academy of Sciences was suppressed in 1793, many of its members, feeling the need for mutual support, joined the comparatively obscure Philomatic Society. They valued the regular meetings, where they were able to associate with their peers, and they only abandoned this society when the Institute was founded, providing renewed recognition of their talents and giving them powerful motivation for future activity.

The eighteenth-century Enlightenment had presented science as an ideal, a liberating force, a demonstrably successful method of interpreting the natural world, which exemplified human progress. For some, science would never be more than a hobby but, by the 1790s, there were already signs that science might provide not only an ideal and a new cultural value but, for the fortunate few, it might provide an avenue of recognition and, as we shall see later, even a career. Membership of the First Class of the Institute would not have delighted everyone but we are talking of men whose life was science, or who wanted their life to be science. They could hardly ask for more in life than to join the inner circle of science. Membership was a great honour. The fortunate few were offered free membership of an elite society, where theoretically they would be on terms of equality with the greatest representatives of science of the age. All would value their new status. Some might value the companionship; others would value the power they could exercise. Having benefited earlier in their careers from patronage, they themselves would now be in a position to exercise patronage. Was there some exaggeration in the comment of a British visitor to Paris during the Peace of Amiens in 1802?

> These members of the Institute borrow everywhere; it is a matter of no small importance to obtain a seat in their hall, for it is the anti-chamber to wealth, fame and power.[18]

There was certainly fame and a certain amount of power, but wealth would only come indirectly and then only in moderation, as we shall see in due course.

[18] Henry Redhead Yorke, *Letters from France*, 1814, vol. 2, p. 15.