

Institutionalization of Scientific Research in the Early Years of the Royal Institution of Great Britain, 1799-1804

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英国王立研究所 草創期の 科学研究的 制度的 定着

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요 약

1799년에 창립된 런던의 왕립연구소는 영국에서 科学의 研究를 제도적으로 '定着'시키는 데 성공한 첫번째 科学研究所였다. 그리고 창립 이후 몇년 동안에 이 연구소의 構造와 運營에 있어서 나타나는 몇가지 뚜렷한 特性들은 이러한 과학연구의 제도적 정착에 큰 기여를 했다.

우선 왕립연구소의 支配人들(managers)은 런던 上流社會의 지도급 인사들이었는데, 그들은 이 연구소를 과학이나 기술의 진흥을 위한 動機에서보다는 자신들의 문화적인 표현의 수단으로서 창립했다. 지배인들은 직접 과학의 연구나 교육에는 종사하지 않았지만 연구소의 운영을 완전히 그들의 손에 장악했으며 그들이 고용한 과학자들에게 순전히 科学的인 일 이외에는 權限을 주지 않았다. 한편 연구소의 財政을 위해서는 全的으로 런던의 富裕層으로부터 公募한 會員들(subscribers)의 會費에 의존했다. 따라서 지배인들은 연구소의 운영을 이러한 회원들을 만족시키는 방향으로 끌고 갔다. 결국 이런 식으로 해서 왕립연구소는 지배인들의 일종의 企業 비슷한 성격을 띠는 기관으로 변했고 과학연구의 제도적 정착은 바로 이런 과정에서 부산물로서 얻어졌던 것이다. 이 논문은 주로 이 과정에 대한 記述과 說明을 펴하고 있다.

Toward the end of the eighteenth century and in the early years of the nineteenth century, many scientific institutions appeared in England in various forms.¹⁾ Some of these institutions were the so-called "literary and philosophical" societies in the provincial citi-

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- 1) For general discussions of the practice of science in this period in England, see E. Halévy, *England in 1815*, tr. by E. I. Watkin and D. A. Barker (London, Ernst Benn, 1924), part III, ch. II; R. E. Schofield, *Lunar Society of Birmingham* (London, Oxford U. Pr., 1963), ch. 1; D. L. S. Cardwell, *The Organisation of Science in England* (London, Heinemann, 1972), revised edn., ch. 2; A. E. Musson and E. Robinson, "Science and Industry in the late Eighteenth Century" in their *Science and Technology in the Industrial Revolution* (Manchester, Manchester U. Pr., 1969), pp. 87-189.

es.²⁾ Some were societies devoted to separate scientific disciplines.³⁾ Others had more specific aims, usually the applications of science to some practical purposes.⁴⁾

The Royal Institution of Great Britain was one of the institutions founded in this period. But it was the most successful and enduring among them: within a few years of its foundation, the Royal Institution established itself firmly as a solid institution under private management, and it soon succeeded in instituting the practice of scientific research within its facilities with public support. In fact, as D. S. L. Cardwell has pointed out,⁵⁾ it seems to have been the only public research laboratory in England for quite some time. The early history of the Royal Institution⁶⁾ reveals several distinctive characteristics interrelated in significant ways. The purpose of this paper is to study carefully these characteristics which shed light on its success in institutionalizing scientific research.

1. Foundation of the Royal Institution: Technological or Cultural Need?

Count Rumford, who played a major role in the foundation of the Royal Institution, was a famous scientist imbued with utilitarian ideals. He originally proposed to form an institution "for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching by courses of philosophical lectures and experiments the application of science to the common purpose of life."⁷⁾ The goal thus stated is a familiar one, echoing the Baconian ideal that lay behind the foundation of the many scientific societies of the seventeenth century.⁸⁾ Even the detailed plan for the facilities of the Royal Institution, such as lecture theatre, model room for machines, laboratory, workshops, and library, resembled Bacon's famous proposal to Elizabeth I.⁹⁾ Yet, this Baconian ideal adopted by the founders of the Royal Institu-

2) E. g., Literary and Philosophical Society of Manchester (founded in 1781); Literary and Philosophical Society of Newcastle (1793); Philosophical Society of Birmingham (1800). For a good and interesting discussion of the Manchester society, see A. Thackray, "Natural Knowledge in Cultural Context: The Manchester Model," *Am. Hist. Rev.* 80 (1974), 672–709.

3) E. g., Linnean Society (1788); Geological Society (1807); Horticultural Society (1809); Astronomical Society (1820); Zoological Society (1826); see, e. g., A. T. Gage, *History of the Linnean Society of London* (London, 1938); M. J. S. Rudwick, "The Foundation of the Geological Society of London: Its Scheme of Co-Operative Research in Its Struggle for Independence," *Brit. J. Hist. Sci.* 1 (1962–63), 325–356.

4) E. g., Pneumatic Institute at Bristol (1792); Board of Agriculture (1793); Society for the Improvement of the Condition of the Poor; The Royal Institution (1799); The Mechanics Institutes in many cities: see, e. g., T. Martin, "Origins of the Royal Institution," *Brit. J. Hist. Sci.* 1 (1962–3), 49–63; T. Martin, "Early Years at the Royal Institution," *ibid.* 2 (1964–5), 99–116; I. Inkster, "Science and the Mechanics Institutes, 1820–50; The Case of Sheffield," *Ann. Sci.* 32 (1975), 451–474.

5) D. S. L. Cardwell, *op. cit.*, p. 37.

6) The most detailed account of the early history of the Royal Institution is still H. Bence-Jones, *The Royal Institution: Its Founders and Its First Professors* (London, Longmans, 1871). T. Martin, *The Royal Institution* (London, Longmans, 1942) is a much shorter but useful account. The recent work by M. Bermann, *Social Change and Scientific Organization: The Royal Institution, 1799–1810* (Ph. D. Thesis, Johns Hopkins, 1971) also contains many useful materials. The minutes of the managers' meetings of the Royal Institution are being published as *The Archives of the Royal Institution of Great Britain: Minutes of Managers' Meetings*, published in facsimile (Yorkshire, Scholar Pr., 1971–) (hereafter abridged as *Minutes*).

7) It was taken officially as part of the long name of the institution: *Minutes* I, 1.

8) For a classic work on the seventeenth century scientific societies, see M. Ornstein, *The Role of Scientific Societies in the Seventeenth Century* (Chicago, U. Chicago Pr., 1928).

9) See, e. g., B. Farrington, *The Philosophy of Francis Bacon* (Chicago, U. Chicago Pr., 1964), p. 15.

tion as their official purpose was not the sole motivation in their founding of the institution.

The utilitarian zeal for practical science widespread in the mid-seventeenth century had already lost its momentum by the end of the seventeenth century.¹⁰⁾ While science had registered great progress since Bacon's time, there had not been practical applications of theoretical science at a substantial level. The direct contribution of scientific knowledge to the rapid industrial development that began to take place in the latter half of the eighteenth century in England was insignificant.¹¹⁾ Nevertheless, the belief that technology would benefit from scientific knowledge was so strong and widespread in the seventeenth century that despite the failure to produce significant examples in the subsequent century, it never died completely and remained hidden in a latent form. Once the rapid industrial progress began to produce tangible results, this naive belief soon reemerged: science was again being pursued with the purpose of, or rather on the pretext of, applying it to technology and aiding the progress of industrial growth. Such was the context for the founding of the societies by the industrialists at the provincial centers toward the end of the eighteenth century. While their practice and patronage of science were to fail to benefit industry in any direct way for some time, the industrialists in these provincial cities still held to the belief that science would produce useful technological knowledge. In founding the new societies they invoked this Baconian belief as their professed motivation.¹²⁾

However, such a Baconian commitment was more the ostensible than the real purpose of these societies. In the case of the Literary and Philosophical Society of Manchester, A. Thackray has cogently argued that the actual purpose was "the adoption of science as the mode of cultural self-expression" by the newly rising industrial class.¹³⁾ The situation seems to have been somewhat similar in the founding of the Royal Institution. Those who were to become the managers of the institution belonged to the aristocratic element in London society.¹⁴⁾ That class consisted mainly of wealthy landowners. Even Count Rumford himself, though he became famous through his scientific research on heat and other practical matters, was a fashionable man widely acquainted among noblemen. Theirs was the class that controlled essentially all the sectors of English society.¹⁵⁾ That hereditary noble men with no immediate industrial involvement professed Rumford's Baconianism strongly suggests the existence of "external" motives for

10) See, e.g., R.E. Schofield, *op. cit.*, 12; H. Lyons, *The Royal Society, 1660-1940* (London, Cambridge U. Pr., 1944), p. 182.

11) For a good discussion of the ways science and scientists make contributions to the industrial progress, see C.C. Gillispie, "The Natural History of Industry," *Isis* 48 (1957), 398-407.

12) For the case of Lunar Society, see R.E. Schofield, *op. cit.*, ch. 5. Thackray also provides some evidences for the case of Literary and Philosophical Society of Manchester, though he discounts their significance as actual motives: e.g., "The search for useful knowledge which would maintain England's industrial supremacy" (*op. cit.*, 685); "The misfortune is, that few dyers are chemists, and few chemists dyers" (*ibid.*, 693).

13) *ibid.*, 678

14) For the background of the managers of the Royal Institution, see M. Bermann, *op. cit.*, esp. ch. 1 and appendix 1.

15) See, e.g., E. Halévy, *op. cit.*

the foundation of the institution, something other than the stated utilitarian aims.

Of course, England at the time was in genuine need of such an institution. The two universities were not located in important cities, and the education they offered in science was inadequate, being both elementary in its content and marginal in its treatment. The Royal Society for its part provided no facilities for scientific research, and was even unable to satisfy the increasing demand for publication of the scientific works. In the eyes of the future managers of the Royal Institution, wealthy and influential aristocrats of London, there was, however, a more immediate reason besides these concerns of public interest. Having seen the rapid industrial progress of the latter half of the eighteenth century, members of the landed class had come to realize the importance of the industry. Moreover, the new managerial and commercial class that had appeared with this rapid industrial growth was now gaining economic strength and emerging as serious competitors and contenders for influence and even dominance in society. While the war with France restrained these industrialists from indulging in a political struggle with the landed gentry, the new scientific societies of the provincial cities, especially those of Manchester and Birmingham, were channels for participation in society and modes of cultural expression in latent competition with the dominance of the aristocracy. Therefore, the moderate success of the provincial societies in supporting scientific research and teaching, which London's own Royal Society failed to bring about, could easily have aroused some feeling of jealousy and rivalry, among London's aristocrats based on class as well as geography.

In this context of cultural competition, Rumford's proposal for a new institution with facilities for scientific lectures and experiments appeared both timely and needed, answering to the rising sense of rivalry. This feeling was frequently exhibited when the managers referred to their new institution as the best "establishment" not just in London but in the whole country :

A great national institution, ... It would be an ill commitment to this Great Metropolis of the British Empire to suppose it possessing less energy of scientific zeal and contenting itself with an "Institution" less extensive and respectable.¹⁶⁾

... an important, useful and interesting establishment not only to the Metropolis, but to the British Empire.¹⁷⁾

(The laboratory) ... will be equal, or indeed superior, to any in this country and probably to any on the continent.¹⁸⁾

(The proprietors and subscribers) ... enjoy an advantage which never as yet has been held out in any scientific establishment, public or private.¹⁹⁾

The institution ... is likely, in progress of time, to become an object of great national importance.²⁰⁾

The same attitude was reflected also in their search for lecturers, always trying to

16) *Minutes* I, 113.

17) *Minutes* III, 100.

18) *Minutes* III, 131.

19) *Minutes* III, 132.

20) *Minutes* III, 308.

get the famous and the best ones in the country. Their first, but aborted, choice, Farish,²¹⁾ was a well-known lecturer at Cambridge. The actual choice, Thomas Garnett, was also a famous itinerant lecturer of the day.²²⁾ The managers even succeeded in persuading John Dalton of Manchester to give a course of lectures for a term.²³⁾

Thus, Baconian utilitarianism provided the conventional justification for a new scientific institution, while the further philanthropic character reflected a preoccupation of the aristocratic class at the time.²⁴⁾ Naturally, those who were engaged in the philanthropic Society for the Improvement of the Condition of the poor showed more zeal,²⁵⁾ but the leading members of the other scientific bodies then existing in London, such as the Royal Society, Board of Agriculture, and the Linnaean Society, took part in the new institution almost routinely.²⁶⁾ The Royal Institution was readily accepted from the outset, therefore, and naturally found its place in London's established scientific structure.

The wealthy public in London supported the Royal Institution quite enthusiastically, thereby reflecting the widespread interest in science that was also evident from the popularity of many itinerant lecturers.²⁷⁾ But despite the professedly utilitarian aims of the institution, the industrial circles in London did not welcome the institution. Those who subscribed to the institution were mostly gentry, of the same class as the managers.²⁸⁾ Even in 1804, when the institution was firmly established in other respects, its model room suffered from a scarcity of model machines. Few or none had been donated by industrialists.²⁹⁾ Such lack of support from the industrialists has sometimes been attributed to their "natural selfishness" and "suspicion that the model might betray their secrets to competitors."³⁰⁾ But the rivalry between the two potentially hostile classes may also have been responsible for it. A letter by Robinson Boulton writing about his impression of the Royal Institution to his father Matthew Boulton, the famous industrialist and financial backer of James Watt, illustrates such hostile feeling very well:

...It may be a very pleasant amusement for the nobility and other idle longers who have never added an iota to the purse of the nation by the sweat of their brow, to diffuse the inventions and advantages acquired by the perseverance and painful study of groveling mechanics.³¹⁾

21) *Minutes* I, 27-28.

22) See, e.g., A.E. Musson and E. Robinson, *op. cit.*, 107, 181; E.C. Patterson, *John Dalton and the Atomic Theory* (Garden City, NJ, Doubleday, 1970), p. 67.

23) *Minutes* III, 151.

24) M. Bermann, *op. cit.*, pp. 66-67.

25) E. Halévy, *op. cit.*, p. 566; T. Martin, *op. cit.* (note 6), p. 4.

26) Of course it did not happen without initial resistance. Sir Joseph Banks, the President of the Royal Society, did not approve the foundation of an independent institution, at first. But after "the respective fields of action of the two bodies were so defined as not to interfere with one another," he supported it and even allowed the use of his house for the managers' meetings, in which he often acted as chairman. see H. Lyons, *op. cit.*, 216-217.

27) See, e.g., I. Inkster, "A Note on Itinerant Scientific Lecturers," *Ann. Sci.* 28 (1971), 235-237; A. E. Musson and E. Robinson, *op. cit.*, pp. 101-111.

28) M. Bermann, *op. cit.*, ch. 5, appendix 1.

29) *Minutes* III, 203.

30) E. Halévy, *op. cit.*, p. 566.

31) Dated February 28, 1800: quoted in M. Bermann, *op. cit.*, pp. 154-155.

The managers held their first meeting at Sir Joseph Banks' house in Soho Square on March 7, 1799. Following the typical English pattern a subscription was raised for financing the institution. Different amounts were set as dues for the proprietors, and for life and annual subscribers.³²⁾ A constitution was adopted. The Earl of Winchelsea, a distinguished nobleman, was chosen as the first president and a royal charter was secured from the King, George III. A house in Albermarle Street was purchased to accommodate the institution. The planned facilities were constructed in it : lecture theatre, apparatus room, repository for instruments, chemical laboratory, workshops, printing press, kitchen, dining room, managers' room, conversation room, reading rooms, and library.³³⁾ Its first scientific staff member, Thomas Garnett, was employed as professor in September, 1799,³⁴⁾ and he began lecturing soon after his arrival in December. Garnett however became ill after a year, and Humphry Davy was hired to substitute for Garnett as an assistant lecturer in February, 1801.³⁵⁾ Thomas young was added as a professor later in the year.³⁶⁾ He and Davy took charge of the lectures and edited the journal of the institution. By early 1802, the Royal Institution was well established. In his report to the managers in April, 1802 Rumford could assert quite confidently that "the Royal Institution of Great Britain may therefore be considered as finished and firmly established."³⁷⁾ And by this time some definite trends that were to characterize the structure and operation of the institution in the following years had already emerged. The next section will analyze these trends.

2. Three-Way Relation among the Three Groups of the Royal Institution: Managers, Scientists and Subscribers

A notable feature of the Royal Institution is the three-way relationship among its three distinct groups: first, the managers; second, the proprietors and subscribers, along with the wealthy public as potential proprietors and subscribers(hereafter this second group will be referred to simply as "subscribers"); and third, the resident scientists.

The managers were not practicing scientists. Although most of them had amateurish interests in science and in its practical application, and though they were actually members of some scientific societies, none of them were directly engaged in the scientific work of the institution, i. e. the lectures and experiments. Instead, they were the owners of the institution. They hired the scientists to do work for their institution, and thus

33) The list and detailed description of these facilities are given in Rumford's letter to the managers on April 26, 1802: see *Minutes* III, 11–19.

34) "as professor and public lecturer in experimental philosophy, mechanics, and chymistry; and also as scientific secretary to the Royal Institution, and editor of the journals": *Minutes* I, 57.

35) "assistant lecturer in chemistry, director of the chemical laboratory, and assistant editor of the journals of the institution": *Minutes* II, 134. He was soon promoted to lecturer on June 1, 1801 and then to professor on May 31, 1802: *Minutes* II, 185; III, 43.

36) "professor of natural philosophy at the Royal Institution, and editor of the journals, together with a general superintendency of the House": *Minutes* II, 203.

37) *Minutes* III, 19. This was over-optimistic, though, for the institution were to undergo a serious financial difficulty at the end of the same year: see below.

their relation with the scientists was that of employer-employee kind. As owners they had authority over the scientists in the institution who used its facilities and resources.

Once they had founded the institution, however, the managers did not finance it themselves, but depended on the public for funds. The subscribers contributed fixed sums of money to the institution as their dues, on which resources the institution was altogether dependent. In return, the subscribers were to draw benefits in the form of admission to lectures and reading rooms. In this sense the relation between the managers and the subscribers can be viewed as that of the owner-client kind. In fact, sometimes the managers expressly did regard the subscribers as a kind of clients who paid the dues for the advantages provided by the institution. For instance, when the managers had to inform the subscribers of their plan to increase the fee, they usually justified the increases by pointing out the increased utility of the institution to the subscribers.³⁸⁾

The relation between the resident scientists and the subscribers was indirect, the connection lying through their relations with the managers. But the pressure of the managers-subscribers relation was often immediately transferred to the scientists, as will be shown later in discussing the situation of the scientists. The scientists-subscribers relation will there be viewed as akin to that of employee and client.

The clear distinction between the managers on the one hand and the employed scientists on the other was novel at the time. It marked the fact that the new Royal Institution had achieved a certain degree of professionalization, being no longer a loose society made of scientific men, but a solid institution with facilities and positions for scientific research and teaching. To be sure, there were examples of some earlier forms of this practice. Joseph Priestley in the Lunar Society of Birmingham, for example, was in a position somewhat similar to those of the employed scientists of the Royal Institution. Priestley was essentially the only scientist of the Birmingham circle who were actually performing research, and his research was more or less subsidized by the other well-to-do members of the circle.³⁹⁾ John Dalton of Manchester's Literary and Philosophical Society also played a similar role.⁴⁰⁾ However, the distinction between these scientists and the other members of their societies was much more ambiguous than the clear manager-scientist distinction of the Royal Institution. Both Priestley and Dalton were regular members of their societies and played important roles in the administration of them. Dalton even went on to become president of the Manchester Society.
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This manager-scientist distinction was development peculiar to England. It reveals an interesting national difference between England and France in the process of the professionalization of scientists. In France, as professionalization evolved, the scientists who performed the scientific work of the scientific institutions took over control of the administration as well.⁴¹⁾ In England, on the other hand, a contrasting situation developed.

38) See, e.g., *Minutes* I, 127; III, 2.

39) For a discussion of Priestly's role in the Lunar circle, see R.E. Schofield, *op. cit.*, ch. 8.

40) See, e.g., E.C. Patterson, *op. cit.*

41) For a general account of the scientific institutions in France at the time, see M. Crosland, *The Society of Arcueil: A View of French Science at the Time of Napoleon I* (Cambridge, Harvard U. Pr., 1967), esp. chs. 3 and 4.

While amateurs and non-scientists shared with the scientists the administration of the still old-fashioned Royal Society,⁴²⁾ the non-scientist group became the managers of the more professionalized Royal Institution, thus limiting the scientists to tasks strictly scientific. This difference reflects another well-known difference between the two nations' scientific practice, i. e. that English scientific organizations lacked the financial patronage from the crown.⁴³⁾ In France the crown, and then the state, played the role of "client," which in England belonged rather to the public as subscribers. Thus, while the French scientists, in becoming professionals, could rely on governmental patronage while eliminating the amateurs and non-scientists from the administration of their institutions, their English colleagues, without governmental financial support, had to seek employment by those amateurs and non-scientists, who then took the task of the administration of the institutions upon themselves.

The exclusion of the scientists from the administrative power of the managers can be viewed as another indirect evidence of the fact discussed in section 1, i. e. that the motive for the founding of the Royal Institution was more cultural than technological or scientific. In other words, if what the managers had in mind in founding the institution was not so much technological or scientific need as "cultural expression", it was natural that they themselves should take charge in its administration and give no authority to the scientists whom they employed. At any rate, this exclusion of scientists from the administration of the institution seems to have had important consequences affecting the workings of the institution, which will be discussed in the following sections.

3. Administration of the Institution by the Managers

After its foundation, the matter which concerned the non-scientist managers of the Royal Institution most was its survival and establishment on a firm footing, and for that, finance of the new institution was most important for the managers. From the beginning, their main effort was on creating an attractive image of the institution to the public, since they had to rely entirely on the payment of the dues from the subscribers for funds. Thus, whenever they had a chance, they never failed to make an optimistic assessment of the success of the institution and to point out the benefit and utility that the institution could offer the subscribers.⁴⁴⁾ Sometimes they were concerned even with details that were trivial but that could still concern the subscribers. For example, a letter of the managers written in January, 1800 to report to the proprietors about the institution's general affairs actually used most of its space to explain their decision not to insert all the names of the proprietors in the charter in order to save 700 pounds in

42) H. Lyons, *op. cit.*, p. 204.

43) The only exception was the Royal Observatory founded in 1675. The reason for this exception may lie in the close relationship of astronomy with navigation and with judicial astrology. See, e. g., E. Halévy, *op. cit.*, p. 556. In France there were also exceptions to the rule, the best example of which was the Philomatic Society that prospered during the time the Academy was suppressed. See, e. g., M. Crosland, *op. cit.*, pp. 169–179.

44) *Minutes* I, 127; II, 192; III, 2, 19, 97, 103, 131–132, 166, 246, 308.

printing cost, while giving assurances that other privileges would remain.⁴⁵⁾ On another occasion, they spent long hours at a meeting in discussing how to differentiate the admission tickets issued to different membership categories, and even took up the issuing of silver and ivory tickets.⁴⁶⁾

The utilitarian and philanthropic goals, of course, remained as the institution's official purpose. They were mentioned repeatedly by the managers and the professors,⁴⁷⁾ and the projects to meet these purposes were being suggested and carried out.⁴⁸⁾ But the managers did not stick to them consistently: whenever the utilitarian and philanthropic goals contradicted their more immediate concerns with the subscribers or with the finance, these goals were readily ignored. The fate of the journal of the institution illustrates this very well. The project for the journal started in 1801, and it began publication the next year. Soon after its start, however, the managers detached themselves financially from it by making it a separate self-supporting project.⁴⁹⁾ This is in sharp contrast with the persistent interest they had shown in the printing and distribution of the small booklet that contained the charter, the prospectus, and the bye-laws of the institution. Although publication of the journal was a matter of much greater scientific importance than the distribution of the charter booklet, the former was more expensive and obviously less appealing to the public than the latter. The managers thus were not willing to pay for the cost of its publication. The journal stopped printing in 1803. Similar was the fate of the project for the school for mechanics proposed by the institution's clerk, Thomas Webster.⁵⁰⁾ The managers approved the project since they could never reject a project so suited to their professed goals. But it was never actually carried out. Even a much less ambitious practice of admitting tradesmen and artisans to the lectures on reduced fee was later discontinued.⁵¹⁾

At the end of 1802 and in the early months of 1803, the Royal Institution met with

45) *Minutes* I, 84-86.

46) *Minutes* I, 83, 87.

47) In Rumford's letter to the American Philosophical Society:

advancement of science, and to the general diffusion of the knowledge of such new and useful discoveries and mechanical improvements, as may tend to increase the enjoyments and promote the industry, happiness and property of mankind...(*Minutes* II, 98)

In Rumford's letter to the managers:

...contribute to the general diffusion of an active spirit of inquiry and useful improvement among all ranks of society...(*Minutes* III, 19)

In the report from the Chemical Department of the institution:

...diffusion of knowledge and application of science to the improvement of arts and manufactures...(*Minutes* III, 132)

In Young's letter to the managers after his resignation:

...advancements and dissemination of mechanical knowledge...(*Minutes* III, 159)

It is interesting to observe the slight differences in tone according to the different persons and circumstances.

48) Davy's lecture on tanning and other practical subjects is a good example: *Minutes* II, 198. For other such examples, see also *Minutes* I, 58-65; II, 43-45; III, 44, 82, 97. The institution's philanthropic character also continued as can be seen from its readiness to allow the use of its committee-room by the Society for the Improvement of Condition of the Poor: see *Minutes* I, 75; II, 191.

49) *Minutes* III, 26-29, 38-39, 43.

50) *Minutes* I, 58-65.

51) *Minutes* III, 102-103.

a serious financial difficulty. In providing the new institution with the necessary facilities and starting various projects the managers spent large sums of money,⁵²⁾ and the income from the dues paid by the subscribers was inadequate. The strain was felt at the managers' meeting held in December, 1802, when they had to plan "special meeting for considering the funds"⁵³⁾ and order an inspection of the financial status of the institution.⁵⁴⁾ The managers had to advance 2000 pounds from their own pockets to meet the deficit,⁵⁵⁾ though this amount was returned to them after the finances were improved. A systematic examination was carried out on the various aspects of the institution, which had thus far been dealt with irregularly in isolation from one another. A long report by the Select Committee presented on March 7, 1803 summed up the recommendations resulted from this examination.⁵⁶⁾

This report shows the managers' realistic understanding of the situation. Naturally, conventional measures of institutional reforms appear among the recommendations, such as increasing the number of the managers, instituting new committees, and ordering a stricter economy. But the main point of the report was in the attempt to confront the financial crisis through augmenting the only regular means of the institution, i.e. the income from subscriptions to the lectures and the reading rooms. For this purpose the managers emphasized increasing the number of annual subscribers while foreclosing admission of new proprietors, who were hereditary, and each of whom held two transferrable admission tickets. The managers even tried to change one of these two transferrable tickets to a personal ticket in order to provide more room for the annual subscribers. They also proposed improvement of the laboratory, the library, and especially the lectures, with the aim of attracting more annual subscribers. The report ended on an optimistic note. And in fact the measures did prove to be successful. The "state of the account of the institution" for 1803 exhibited a surplus income of 608 pounds on top of many improvements made on the facilities as well as discharging of all the debts. It proudly asserted:

Nothing at present seems to be desired, but that the managers may be induced and encouraged to preserve in that degree of zeal and attention, to which the institution owes the great improvements made during the preceding year; improvements which offer every reasonable prospect of increased advantage and extended utility.⁵⁷⁾

In the efforts to overcome the crisis, the managers thus established their institution on

52) From its foundation in March, 1799 till the end of 1802, the Royal Institution spent about 24,000 pounds, of which the important items were as follows:

house : 4,850 for the original purchase

8,609 for the new building and repairs

1,550 for furniture

apparatus and chemicals : 1,120

books and newspapers : 613

workshop : 1,101

books and newspapers :

other annual expenses including tax, salaries and wages : 3,984 (*Minutes* III, 122-125)

53) *Minutes* III, 63.

54) *Minutes* III, 66.

55) *Minutes* III, 75.

56) *Minutes* III, 93-103.

57) *Minutes* III, 261-264.

a firm financial basis.

However, in the course of overcoming the crisis, the managers turned away farther and farther from their original utilitarian and philanthropic goals. Instead, the activities of the institution tended to be directed more and more towards the satisfaction of the public. The result was that the managers had to face and accept the new reality: science could be practiced in the absence of ostensible practical and philanthropic benefits. Lectures even on architecture, belles-lettres, painting, music, history, and moral philosophy were given in the institution.⁵⁸⁾ The Royal Institution became a kind of fashionable social club for the well-to-do public.

This switch, however, had its positive aspects. For one, by successfully manipulating the public's interest, the Royal Institution fully established the feasibility of looking to the public for financing. Although the institution had a royal charter which might have indirectly helped in raising the subscription by adding prestige to the image of the institution, it obtained no actual financial support from the crown. The institution sought financial support entirely from the public. Furthermore, the subscription was raised essentially without any screening. Almost anybody who could afford to pay the dues was entitled to join the institution as a subscriber. In almost all recorded cases from the founding till the end of 1804, the names of those proposed as proprietors and subscribers were always approved. There seems to have been no additional screening other than payment of dues. In fact, the managers were more concerned with recruiting subscribers than with screening them. This can then be viewed as finance by the anonymous public, and in this manner the Royal Institution came to have a sounder financial basis than it would have had if it had depended on an individual or on a group of people, connecting its fate with their fortunes.

There was another and more important consequence of the switch. In forsaking the professed utilitarian ideal of the institution in order to meet the pressure to survive, the managers abandoned the external goal of the institution, i. e. the practical application of science. Abandoning such a goal proved to be an advantage for the Royal Institution, considering the fates of the scientific organizations such as the Board of Agriculture, Pneumatic Institute, and Society for the Improvement of the Condition of the Poor. These organizations were tied to specific external goals and when interests in these goals faded the organizations disappeared. But the Royal Institution continued to exist. It did not only survive, but it instituted a new practice in the place of the external goal, namely scientific research on the part of its resident scientists. The practice of scientific research by the scientists thus became an internal goal of the institution. The next section will deal with the scientific research by the scientists of the Royal Institution.

4. Scientific Research by the Scientists

The scientists of the Royal Institution were kept under close supervision by the managers. The scientists were given no power in the general administration of the insti-

58) *Minutes* III, 203-205, 284-285

tution. Even in the areas which required scientific expertise, such as hiring of the Scientific staff and preparation of the syllabuses for lectures and experiments, decisions were made by the Committee of Science formed by the managers. Although their opinions were generally respected and their requests were usually granted, the scientists had to obtain permission of the managers in almost everything. To cite just a few examples, Young and Davy had to obtain approval of the managers for their schedules of vacations in the summer;⁵⁹⁾ Young had to obtain approval of the managers for the editor's preface he had written for the journal;⁶⁰⁾ Davy had to obtain permission even for admitting private pupils to the laboratory to assist him in performing experiments.⁶¹⁾

In addition to such overt supervision by the managers, there was, for the scientists, the indirect pressure, i.e. that they had to satisfy the subscribers. For a successful career as resident scientist in the institution, the ability to please the audience in the lectures became essential. Davy's immense success in the institution certainly has a lot to do with his performance as a lecturer. He prepared his lectures with extreme care. His brother, John Davy, writes:

It was an invariable rule with him (i.e. Humphry Davy), the evening before, to rehearse his lecture in the presence of his assistants, ... He used, at this recital, to mark the words which required emphasis, and study the effect of intonation; often repeating a passage two or three different times, to witness the difference of effect of variations in voice. His manner was perfectly natural, animated, and energetic, but not in the least theatrical.⁶²⁾

The meticulous care with which Davy prepared the lectures was not restricted to his own. When John Dalton visited the Royal Institution to give a course of lectures, Davy helped him prepare the lectures with the same care. Dalton wrote:

Mr. Davy advised me to labour my first lecture; he told me the people here would be inclined to form their opinion from it; ... the evening before the lecture, Davy and I went into the theatre; he made me read the whole of it; and he went into the farthest corner; then he read it and I was the audience; we criticized upon each other's method.⁶³⁾

On the other hand, Garnett and Young performed poorly in their lectures, which may have been responsible for their brief tenures.⁶⁴⁾

Supervision by the managers and the pressure to satisfy the subscribers in the lectures, however, were not just restrictions and burdens to the scientists of the institution. The scientists were freed from financial and administrative responsibility for the institution, and instead received financial support. Except for the assigned lecture duties, they were free in their practice of science. Even independent research was possible using the facilities of the institution, at least during off-duty hours. And once the external goal of utilitarian and philanthropic ideals were forsaken, there were no real req-

59) *Minutes* III, 51.

60) *Minutes* III, 87.

61) *Minutes* III, 295.

62) J. Davy, *The Collected Works of Sir Humphry Davy* (hereafter abridged as *Works*), vol. 1, p. 92.

63) In a letter to John Rothwell (dated 10 January 1804): quoted in E. C. Patterson. *op. cit.*, p. 126.

64) See, e.g., H. Hartley, *Humphry Davy* (London, Nelson, 1966), p. 40; T. Martin, *op. cit.* (note 6), p. 7.

uirements in the choice of lecture subjects other than that they should be appealing to the subscribers. The lectures could freely incorporate results of interesting new research. Research could now be viewed as part of the official duties of the scientists.

Such a position in the Royal Institution must have been particularly attractive to a man like Davy, who, just beginning his career, was not quite established and thus would accept the restrictions and burdens with less misgivings than more established scientists like Garnett, Young, or Rumford would experience.⁶⁵⁾ Instead, Davy possessed an intense zeal for work that used the facilities of the institution. His subject, chemistry, was also perfectly suited to such a position, for, being at the early stage of what Thomas Kuhn calls normal science,⁶⁶⁾ it was sufficiently established and advanced to show some elegance and coherence, but not too advanced to interest, or to be understood by, the lay audience.⁶⁷⁾ This enabled Davy to lecture on the topics of his current research. In fact he was able to spend most of his time in performing experiments in the field of his own interest, i. e. voltaic electricity and its chemical effects.⁶⁸⁾ On the whole, Davy was financially in a much better condition to do scientific research than most of his contemporary scientists. At the time when even in France "it was common for a man to buy his own apparatus for research,"⁶⁹⁾ Davy was supplied, by subscription, with a huge galvanic pile made of 2000 double plates costing over 1000 pounds.⁷⁰⁾ With respect to the lecture load, too, Davy appears to have been far better off than his French colleagues, who, often with remorseful misgivings, had to accept several teaching positions at once for living.⁷¹⁾

The preceding pages have shown the process in which the practice of scientific research was institutionalized in the Royal Institution. The non-scientist managers founded the institution and took charge of its administration. They employed the scientists for

65) The exact situation concerning the resignations of Garnett and Young is not clear. Both had requested an increase of salary, and the request had been rejected shortly before they resigned. See *Minutes* II, 180; III, 129. Count Rumford was a manager himself, but he was charged with technical duties and was to a degree supervised by the managers. Martin suggests that he had difficulties with the managers before he left the institution: see T. Martin, *op. cit.* (note 6), p. 5. For a more detailed discussion of Rumford's role in the Royal Institution, see M. Bermann, *op. cit.*, chap. 3.

66) T. S. Kuhn, *The Structure of Scientific Revolutions*, second edition (Chicago, U. Chicago Pr., 1970), pp. 10ff.

67) Essentially the same point was noted by J. Davy, *Works*, I, 90.

68) To be sure, at the beginning he had to perform experiments on practical subjects such as tanning, dyeing and printing that are remotely connected with chemistry. Bermann even argues that this was the major scientific concern of the Royal Institution and that the managers' material interests were closely connected with tanning. Bermann further argues that, with his success in research on tanning, Davy paid back the managers and reinforced their belief in science as something they could invest in. However, this argument is not convincing, for it is hard to believe that, if Davy's research on tanning had actually brought material benefit to the managers, they would not have attempted to steer him again into that kind of work. Furthermore, instead of forming a separate series of lectures as had been planned originally, the research on tanning, together with all the other topics in the practical arts, constituted a small part of a course of lectures in chemistry to a general audience. See, M. Bermann, *op. cit.*, chap. 4; *Works* II, pp. 327-466.

69) M. Crosland, *op. cit.*, p. 224.

70) *Works* V, p. 283.

71) M. Crosland, *op. cit.*, pp. 224-231.

the scientific tasks of their institution. For finance, on the other hand, they depended on the public as subscribers, and steered the direction of the scientific practice of the institution accordingly in order to satisfy the public. The Royal Institution thus became an enterprise of its managers, while the practice of scientific research by its scientists emerged as a by-product of this process. The motive behind the managers' efforts to preserve and expand their institution must be complex. To be sure, they must have been seeking some form of benefit in return for their efforts, but it was definitely not a material one. A personal satisfaction with their engagement in a worthy project; a prestige in connecting their names with a successful establishment; perhaps from a class rivalry; or even for the national glory; -any or all of these could have been responsible for it.

At any rate, this mode of conducting science is rather familiar today, as it reminds one of the large-scale state and private scientific establishments of today. With all the imperfections that prevent one from calling the Royal Institution, along with other scientific organizations of the time, a modern scientific institution, it nevertheless evolved a characteristic in scientific practice that is distinctly modern.