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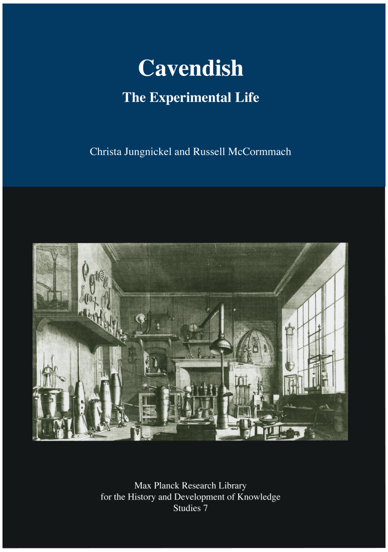
Christa Jungnickel and Russell McCormmach:

Learned Organizations



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Chapter 10
Learned Organizations

Royal Society

At the time Cavendish entered the Royal Society, its membership was stable, as it had not been before and would not be after. During the twenty years centering on 1760, the average number of ordinary members was practically constant, around 350, whereas it had grown by nearly one quarter in the thirty years after Cavendish's father had joined. The foreign membership was now at its maximum, around 160, forty percent larger than it had been thirty years before; thereafter it slowly declined owing to a deliberate policy of the Society to stop the escalation of the honorary segment of its membership.[1]

Beginning in 1753, candidates for membership had to be known "personally" to their recommenders. Throughout his fifty years in the Society, Cavendish recommended a new member every year or two, somewhat over thirty all told. The first time he signed a certificate proposing a new member, he did so with his father, whose name appears first; that was the only time the two made a recommendation together, his father naming only four more recommendations. Four of the first five candidates Cavendish recommended were Cambridge men, and because he knew them "personally," he probably had met them in Cambridge. The first was Anthony Shepherd, recently appointed Plumian Professor of Astronomy and Experimental Philosophy at Cambridge. Shepherd was ten years older than Cavendish, but the other three had been fellow students: the mathematician and barrister Francis Maseres, the astronomer and cleric Francis Wollaston, and the antiquarian and diplomat John Strange. In the cases of Maseres and Wollaston, Cavendish was first to sign their certificates. At this time, persons Cavendish wanted in the Society were associated with the physical sciences, with exceptions. John Strange was a member of foreign botanical societies and John Cuthbert, the one candidate Cavendish recommended who was not from Cambridge, was an attorney, whose certificate read, "well versed in polite Literature."[2]

A further indication of the continuity of his years in Cambridge is the list of guests he brought to the Royal Society Club. Starting in 1766, six years after he became a member, the Club identified guests with the persons who brought them. We see that Cavendish's first five guests after that year were Cambridge men, all either about to leave Cambridge or had already left. William Ludlam was a little older than Shepherd and then a fellow of St. John's College, but soon to vacate his fellowship to accept a rectory. He published a book of astronomical observations made at St. John's in 1767–68, including an account of several astronomical instruments and calculations made for him by Charles Cavendish; both Henry

[1] 19 Dec. 1765, 6 Feb. 1766, Minutes of Council, Royal Society (UPA film ed.) 5:146–148, 153–154. It was resolved that no more than two foreigners a year would be admitted until their number fell to eighty.

[2] Certificates, Royal Society. Dates of proposal: Anthony Shepherd, 2:242 (19 Jan. 1763); John Strange, 2:343 (early Jan. 1766) ; Francis Wollaston, 3:65 (3 Jan. 1769); Francis Maseres, 3:104 (31 Jan. 1771); John Cuthbert, 3:312 (7 Mar. 1765).

and Charles invited Ludlam to the Club as their guest in 1767.[3] Another guest of Henry's was John Michell, formerly the Woodwardian Professor of Geology at Cambridge, who in the year Henry invited him to the Club, 1767, became rector of Thornhill in Yorkshire. Henry's three other guests were his age and had been at Cambridge when he was: John Strange again, Henry Boult Cay, a fellow of Clare College, Cambridge, who was soon to vacate his fellowship to practice as a barrister of the Middle Temple,[4] and Wilkinson Blanchard, a fellow of the College of Physicians and a physician to St. George's Hospital in London. Cavendish also brought guests to meetings of the Royal Society, and again there was a Cambridge connection: around this time, in 1767 and 1768 he invited Francis Wollaston, and in 1769 he invited Ludlam.[5]

For further information about Cavendish's associations we return to the book of certificates recommending candidates for fellowship in the Royal Society. His recommendations reflected his current scientific activities. After his first recommendations of candidates from Cambridge mentioned above, his next, in 1769, was of Timothy Lane, who was then working in electricity and chemistry, the same as Cavendish. Cavendish's first foreign candidate was the electrical researcher Jean-Baptiste Le Roy in 1772, the year after Cavendish's published his electrical theory.[6] In the mid-1780s Cavendish undertook several tours of Britain, making industrial and geological observations and investigating specimens from furnaces and minerals from the Earth. The candidates he recommended then included James Watt, who is identified on the certificate as the inventor of the new steam engine and the author of a paper on chemistry; James Keir, a former glass and now alkali manufacturer, who is identified as the author of a paper on the crystallization of glass and the editor of a dictionary of chemistry; and James Lewis Macie (James Smithson) and Philip Rashleigh, both identified with chemistry and mineralogy. Cavendish's recommendation of the foreign geologist Horace Bénédict de Saussure belongs to this group too.[7] In the late 1780s, when Cavendish's chemical publications came to an end and he abandoned the phlogiston theory of chemistry, he welcomed into the Royal Society as foreign members the leaders of the new anti-phlogistic chemistry: its inventor Antoine Laurent Lavoisier, and his colleagues L.B. Guyton de Morveau and Claude Louis Berthollet. In the same period, when Cavendish brought together his wide-ranging experimental and theoretical work in heat, he recommended the Swedish master of the subject of heat, Johan Carl Wilcke.[8] In 1789 Cavendish recommended Pierre Simon de Laplace for his work in mathematics and astronomy, and every foreign member after that, with one possible exception, ten all told, were likewise known for their work in mathematics and astronomy, the fields that Cavendish was then pursuing. This sizable foreign group consisted of Joseph Louis Lagrange, Jean-Baptiste Joseph Delambre, Joseph Mendoza y Rios, Gregorio Fontana, David Rittenhouse, J.H. Schroeter,

[3] 14 May 1767, Minute Book of the Royal Society Club, Royal Society, 5. William Ludlam (1769). "Ludlam, William," *DNB*, 1st ed. 12:254–255.
[4] 14 May 1767, 30 June 1768, and 16 Feb. 1769, Minute Book of the Royal Society Club, Royal Society, 5. Archibald Geikie (1917, 91, 100).
[5] 26 Feb. 1767, 8 Dec. 1768, and 9 Feb. 1769, JB, Royal Society 26.
[6] Certificates, Royal Society. Proposed: Timothy Lane, 3:73 (6 May 1769); Jean-Baptiste Le Roy, 3:161 (5 Sep. 1772).
[7] Certificates, Royal Society. Elected: James Watt, 5 (24 Nov. 1785); James Keir, 5 (8 Dec. 1785); James Lewis Macie (James Smithson), 5 (19 Apr. 1787); H.B. de Saussure, 5 (3 Apr. 1788); Philip Rashleigh, 5 (29 May 1788).
[8] 30 Apr. 1789, Certificates, Royal Society 5.

Joseph Piazzi, Franz Xaver von Zach, W. Obers, and Carl Friedrich Gauss.[9] We postpone to the end of this section our discussion of a large group of world travelers recommended by Cavendish.

Of the almost one hundred fellows of the Royal Society who joined Cavendish in recommending candidates, only a few appear with him on more than one certificate. Nevil Maskelyne appears on half of the certificates, and after him, in decreasing frequency, come the keeper of the natural history department of the British Museum Daniel Solander, William Watson, James Burrow, and William Heberden. Several of these persons were cosigners with Cavendish's father. From this record, we might conclude that he was not part of a faction. His frequent appearance with Maskelyne reflects their common Cambridge education, with its emphasis on mathematics, and their common interest in the physical sciences, especially astronomy.

In 1765 Cavendish was elected to the Council of the Royal Society,[10] the first of thirty-four times. We get some idea of what this involved from the frequency of Council meetings and the record of his attendance. Over the first twenty years after he became a member of the Royal Society, 1761 to 1780, the average number of Council meetings per year was seventeen, the number falling to eleven or twelve over the next twenty years, 1781 to 1800. The four officers of the Society—president, treasurer, and two secretaries—came to most of the Council meetings, but on the average fewer than seven of the twenty-one members attended. In his first year on the Council, other than for the two secretaries, Cavendish attended with greater regularity than anyone, and this became his pattern; like his father, when he was on the Council, he rarely missed a meeting. After his first term on the Council, for the next twenty years he was on it about half the time. A historian of the Royal Society lists the longest-serving members of the Council over a period of forty-two years, beginning twelve years after Cavendish first served. In the first half of the period, 1778–1800, a total of 171 members of the Society were elected to the Council; the great majority, eighty-eight percent, were elected for only one or two years; nine served three years; five served four or five years; and only four served more than ten years:[11]

W. Musgrave	22 years
N. Maskelyne	20 years
H. Cavendish	17 years
Lord Mulgrave	14 years

[9]Royal Society, Certificates. Elected: Pierre Simon de Laplace, 5 (30 Apr. 1789); Joseph Louis Lagrange, 5 (5 May 1791); Joseph Delambre, 5 (5 May 1791); Joseph Mendoza y Rios, 5 (11 Apr. 1793): Gregorio Fontana, 5 (10 July 1794); David Rittenhouse, 5 (6 Nov. 1794); J.H. Schroeter, 5 (19 Apr. 1798); Joseph Piazzi, 6 (11 Apr. 1803). Proposed: Franz Xaver von Zach, 6 (17 Nov. 1803); W. Obers, 6 (17 Nov. 1803); Carl Friedrich Gauss, 6 (17 Nov. 1803).

[10]30 Nov. 1765, JB, Royal Society 25:663.

[11]Lyons (1944, 197–204).

For 1801–1820, the years are:

C. Blagden	19 years
Lord Morton	18 years
N. Maskelyne	11years
H. Cavendish	10 years

Cavendish died in 1810, halfway through the second span. If we look at the last twenty-five full years of Cavendish's life, 1785–1809, we find that Cavendish's record was unsurpassed: he served on the Council every one of those years.[12]

We have an idea of the scientific company Cavendish kept on the Council: it is estimated that the average number of scientifically active members on the Council over the twenty years 1761–1781 was between nine and ten, and over the next twenty years 1781 to 1800 it was under seven. Because the activities of the Royal Society constituted a substantial part of Cavendish's working life, we should have an idea of what that work consisted of. We begin with his first year on the Council, dating from the end of 1765, when he took his oath along with other new members. The year's activity started with a courtesy related to the "Royal" in the name Royal Society, a gift to the king of bound volumes of the *Philosophical Transactions* for the last fifteen years. Through Cavendish's first year, the journal came to the attention of the Council in a number of ways: rules for authors' corrections of their papers, sales of the journal, payment for stocking future volumes, payment to printers, engravers, and stationers, and orders of copies of the journal printed that year. The membership of the Society came up in Council meetings. Through several resolutions, the Council in addition to limiting the number of new foreign members specified the procedure of their nomination and the conditions of their election, exempting from restrictions sovereign princes and their sons, ambassadors, foreigners living in England, and presidents of foreign academies of sciences. While revising the Society's practice of admitting foreigners, the Council ordered 1000 copies of its charter for distribution to the members. Other business included salaries paid to the two secretaries, the assistant secretary for foreign correspondence and translation, and the clerk. Bills were ordered to be paid by the treasurer for sundry purposes, principally to instrument makers, in particular for the instruments acquired to confirm John Canton's experimental proof of the compressibility of water. In addition to statutes, membership, journal, and bills and revenue, the Council took up a range of scientific matters. That spring Cavendish reported on his first project for the Society, a determination of the best method of fixing the boiling point on thermometer scales. The summer of 1766 saw the beginning of the Society's long preoccupation with the transit of Venus in 1769. In a letter to the president, Cavendish brought before the Council his recommendations of proper places in the world for observating the transit of Venus. The Council resolved that one or more astronomical observers be selected and that Roger Joseph Boscovich, a foreign member of the Royal Society and professor of mathematics at Pavia, be approached. For several years, the Society's Copley Medals for the best research in a given year had not been disposed, though there had been good papers during that time. To make up for this, the president proposed that three medals be given that year, one of which went to Cavendish

[12]From a survey of the Minutes of Council, Royal Society 5–8.

for his first paper. The final item of business that year was an audit of the Society's income and expenses, the treasurer's account. Cavendish was named one of the auditors along with James Burrow and George Lewis Scott; when they were finished, Cavendish reported to the Council in the name of the three auditors, a degree of prominence he could accept. The balances were small, but that did not diminish the responsibility of the auditors; Cavendish was joined on the committee of auditors in subsequent years by Maskelyne, Franklin, and other stalwart members. Five years after his election, Cavendish was clearly an important member of the Society. Moreover, by demonstrating his knowledge and skill in astronomy, instruments, heat, and chemistry, he was recognized as a natural philosopher of broad competence, a valuable asset in the Society's wide-ranging activities.[13]

We look ahead. Cavendish was extensively engaged in two major projects initiated by the Society during his time, the one just mentioned, observations of the transit of Venus in 1769, the second an experiment on the attraction of mountains in 1774. He drew up plans for a voyage of discovery to the Arctic; he worked on changes in the statutes of the Society and in the printing of the *Philosophical Transactions*; he was appointed to committees concerned with meteorological instruments of the Royal Society and astronomical instruments of the Royal Observatory; and he served on committees called into being by requests of the government. He was appointed to twenty-three committees, more or less,[14] and he took on assignments for the Society that did not involve a committee but at most an instrument maker to work with him. Altogether, Cavendish worked with about sixty fellows on special committees. Since the work of the Society was spread around, usually other fellows appeared on only one committee with him, the exceptions being Maskelyne, the astronomer royal, and the astronomer Aubert, who was an expert on meteorological it as well as astronomical instruments.[15]

Like his father, Cavendish served regularly on the committee of papers,[16] which attracted able men regardless of their habits of publication; some of them, such as Maskelyne and William Herschel and Cavendish himself, were themselves authors of many papers in the *Philosophical Transactions*, but others, such as Aubert, published next to nothing. In addition to attending the meetings of the committee, which took place monthly as needed, the members had homework. On any particular paper, the committee could make one of several decisions: to print, not to print, to withdraw, or to postpone. If postponed, the paper might be referred to one or two members. In the case of strong disagreement over a given paper, the matter could be taken up by the Council of the Society. That was done in 1789: Cavendish gave the Council his reasons why a paper that the committee had ordered printed in the *Philosophical Transactions* should not be printed; the Council then recommended to the committee that it "reconsider their former vote on the subject of the said paper."[17]

[13]Entries from 19 Dec. 1765 to 30 Nov. 1766: Minutes of Council, Royal Society 5: 143, 145–153, 155–158, 160–161, 163–164, 167, 169. Henry Cavendish (1921a). Henry Cavendish to James Douglas, earl of Morton, [9 June 1766], draft, in Jungnickel and McCormmach (1999, 531–533). Cavendish would later be appointed to a committee of eight to consider places for observing the transit. 12 Nov. 1767, Minutes of Council, Royal Society 5: 184.

[14]It depends on how one counts. Committees were often renewed, sometimes becoming virtually new committees with the same or a redefined task.

[15]Cavendish served on eight committees with Maskelyne and as many with Aubert.

[16]From a survey of the bound volume of minutes of the Royal Society's committee of papers, 1 (1780–1828).

[17]The paper proposed a new and easy method for determining the difference of longitude. 19 Feb. 1789, Minutes of Council, Royal Society 7:201.

Following Cavendish's report in 1766, the Council undertook painstaking preparations for observing the transit of Venus in 1769, which was the second of these rare, paired crossings of the Sun's disk, affording an accurate measure of the Sun's distance (Fig. 10.1). The Society had completed its work on the 1761 transit, with rather disappointing results. At the time, the secretary of the Society Thomas Birch wrote to Philip Yorke that the observations of the transit "differ so considerably from each other […] that it is question'd whether the Credit of the Conclusions to be drawn from them will not be much weaken'd: and I am apprehensive that our Astronomers, if not Astronomy itself, will suffer a little in Reputation." Pride as well as science called for a repetition of the measurement. Having learned from their errors in 1761, astronomers planned their observations for 1769 with meticulous care.[18] Charles Cavendish, as we have seen, did considerable work on the first transit of Venus; beginning to end, Henry Cavendish did the same on the second.

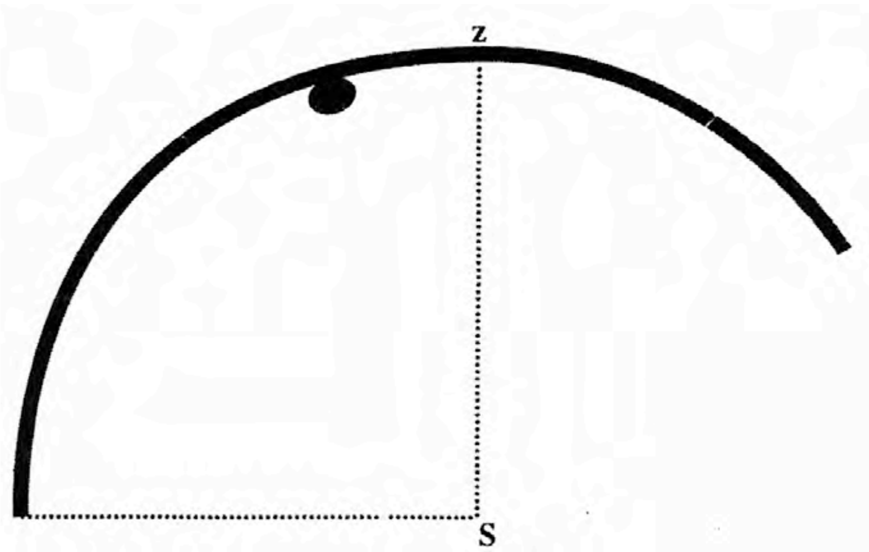

Figure 10.1: Transit of Venus. On the Island of Maggeroe, on the North Cape of Europe, the transit of Venus of 1769 was observed by William Bailey, who was sent there by the Royal Society. The event was partly obscured by clouds but not completely, as shown by his drawing (which has been redrawn for this book). "Astronomical Observations Made at the North Cape, for the Royal Society," *Philosophical Transactions* 59 (1769): 262–66, on 266.

Cavendish studied the observations of the earlier transit of Venus of 1761 at a time when he was carrying out chemical experiments on air. There was a connection of sorts. During the first transit, the effect of the air of Venus was not considered, with the result that the reported times of contact of Venus and the Sun were discordant.[19] By making different assumptions about the elastic fluid constituting the atmosphere of Venus, Cavendish com-

[18]Thomas Birch to Philip Yorke, 13 June 1761, BL Add Mss 35399, f. 202.
[19]H. Spencer-Jones (1948, 16).

puted the errors of observation owing to the refraction of light passing through it from the Sun to the observers on Earth.[20] Before Cavendish was done with his work on the transit of Venus of 1769, he had written over 150 pages.[21] As it turned out, the observations of the second transit did not result in an unambiguous figure for the distance of the Sun, but the accuracy of the estimate was markedly improved, and the project could be counted as a respectable achievement of measuring science.

In a letter in 1771 from Maskelyne to Cavendish, we first hear of Cavendish's participation in the other major scientific project of the Royal Society in the second half of the eighteenth century, the experiment on the attraction of mountains to determine the average density of the Earth.[22]

While at St. Helena to observe the transit of Venus in 1761, Maskelyne made an experiment with a pendulum clock to compare the force of gravity there with that at the observatory at Greenwich. He drew no conclusions from the comparison about the figure of the Earth or the law of change in the force of gravity with latitude, since there was reason to think that the Earth is not homogeneous, in which case the force of gravity depends not only on the external figure of the Earth but also on its internal constitution and density. In a paper written as a letter to Charles Cavendish, Maskelyne said that other kinds of experiments than those with pendulum clocks would have to be made to "be able to infer any thing with certainty, concerning the internal constitution of the Earth, or even to determine its external figure."[23] For the same reason, Henry Cavendish told Maskelyne that the attraction of a mountain was preferable to a pendulum clock for determining the average density of the Earth, being less affected by any inhomogeneity.[24] A few years earlier, Cavendish had been concerned with the deviation of a plumb line by the attraction of mountains in connection with errors in measuring degrees of latitude, and he calculated errors for a number of hilly places around the world, including the Allegheny Mountains.[25] He gave his paper on rules for computing such errors to Maskelyne who made use of it in a publication in 1768 about Charles Mason and Jeremiah Dixon's determination of the length of the degree of latitude in Pennsylvania and Maryland. Cavendish was thoroughly familiar with calculations of the attraction of mountains.[26]

The Royal Society's experiment had a history. In 1738 French observers measured the deflection of a plumb line on a mountain in South America. They made use of two stations, one on one side of the mountain, and one on the other side several miles away on the same latitude, sufficiently removed from the gravity of the mountain. The same star was viewed from both stations, directly overhead as determined by a plumb line at the distant station

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[20] Henry Cavendish, "On the Effects Which Will Be Produced in the Transit of Venus by an Atmosphere Surrounding the Body of Venus," Cavendish Mss VIII, 27.

[21] In addition to "Thoughts on the Proper Places for Observing the Transit of Venus in 1769," letter to Morton, and "On the Effects […] by an Atmosphere," Cavendish wrote these studies: "Computation of Transit of Venus 1761, 1769," "Method of Finding in What Year a Transit of Venus Will Happen," "Computation of Transit of 1769 Correct," and "Computation for 1769 Transit," Cavendish Mss VIII, 30–33.

[22] Nevil Maskelyne to Henry Cavendish, 10 Apr. 1771; in Jungnickel and McCormmach (1999, 535). The discussion of the attraction of mountains is based on Russell McCormmach (1995).

[23] Nevil Maskelyne (1762, 442).

[24] Henry Cavendish, "Paper Given to Maskelyne Relating to Attraction & Form of Earth," Cavendish Mss VI(b), 1:20.

[25] Henry Cavendish, "Rules for Computing the Error Caused in Measuring Degrees of Latitude by the Attraction of Hilly Countries," Cavendish Mss XI, Misc.

[26] Henry Cavendish, "Attraction of a Solid on a Point in Its Surface," Cavendish Mss VI(b), 11.

and forming a small angle with a plumb line at the other station owing to the attraction of the mountain. The measurements were found to be inexact, and the French hoped that other observers would succeed on a better mountain.

In the middle of 1772, Maskelyne proposed to the Royal Society the mountain experiment that he and Cavendish had discussed. The Council appointed a committee with Maskelyne and Cavendish on it to prepare the experiment and to call on the treasurer as needed.[27] Cavendish worked out rules for the attraction of mountains, which Maskelyne found "well calculated to procure us the information that is wanted."[28] In a paper he wrote for Franklin, who was on the committee, Cavendish explained that the meridian altitudes of stars were to be observed at both the north and the south feet of a mountain capable of exerting a sensible attraction, giving the relative inclinations from the vertical of the plumb line at those two locations. The chief criterion for the choice of a mountain was that the relative inclinations should be as great as possible, for which purpose the want of attraction of a deep valley was as good as the attraction of a mountain and perhaps better.[29] (Fig. 10.2). As the one who did the extensive planning, Cavendish reported to the Council on the committee's resolutions in the middle of 1773.[30] The surveyor and astronomer Charles Mason was directed by the Council to ride horseback into the Scottish Highlands to survey mountains suitable for the experiment, and on his return to survey further mountains on the borders of Yorkshire and Lancashire. In early 1774, the committee decided on Schehallien (the usual spelling of the time), a 3547–foot mountain in Perthshire in Scotland[31] made to Cavendish's order: big, regular, detached, with a narrow base in the north-south direction (Fig. 10.3). The committee selected Maskelyne to make the experiment. His Greenwich assistant Reuben Burrow and a local surveyor determined the size and shape of the mountain, while Maskelyne observed forty-three stars from it.

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[27]Nevil Maskelyne (1775a); read in 1772. 23 July 1772, Minutes of Council, Royal Society 6:145.

[28]Nevil Maskelyne to Henry Cavendish, 5 Jan. 1773; in Jungnickel and McCormmach (1999, 538). Having made a copy, Maskelyne returned Cavendish's "Rules for Computing the Attraction of Hills." The preliminary version of that paper is Henry Cavendish, "Thoughts on the Method of Finding the Density of the Earth by Observing the Attraction of Hills," Cavendish Mss VI(b), 2, 6.

[29]The Royal Society's experiment would differ from the French one in that the two stations were both on the mountain, one on the north side and one on the south side. Henry Cavendish, "On the Choice of Hills Proper for Observing Attraction Given to Dr Franklin," Cavendish Mss VI(b), 3:1, 5. Among his manuscripts are extensive calculations of the attraction of conical hills with circular and elliptical bases. Other manuscripts treat specific mountains in Scotland, candidates for the experiment: Skidda, supposed to be a cone with a circular base, Maidens Pap, Ben Laas, and others. Cavendish Mss XI, Misc.

[30]29 July 1773, Minutes of Council, Royal Society 6:185–186. The committee which met on 18 July to approve the resolution consisted of Cavendish, Barrington, Horsley, Maskelyne, Watson, and the secretaries Maty and Morton.

[31]27 Jan. 1774, Minutes of Council, Royal Society 6:210–211. The spelling varied. In this entry of the Minutes, the mountain is written "Sheehalian Maidens Pap."

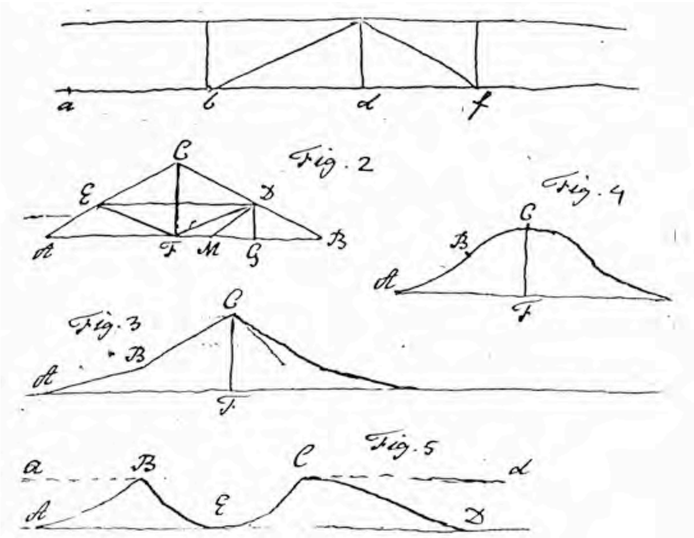

Figure 10.2: Cavendish's Drawings of Mountains. For the experiment by the Royal Society to measure the gravitational attraction of a mountain as a means for determining the average density of the Earth, Cavendish drew up rules for selecting the mountain for the purpose. He considered a number of shapes. "Mr.Cavendish's Rules for Computing the Attraction of Mountains on Plumblines," Cavendish Scientific Manuscripts VI (b), 2. Courtesy of the Chatsworth Settlement Trustees.

Figure 10.3: Schehallien. Photograph of the mountain showing its advantageous geometry for determining the average density of the Earth. Wikimedia Commons.

The meridian distance between the north and south observation stations was measured too in order that the change in the zenith distances of the stars owing to the slightly different latitudes of the two stations could be corrected for. The main instruments for measuring were a theodolite and rods. The main instrument for taking observations was a zenith sector, a telescope designed to observe stars directly overhead, as determined by a plumb line. When the experiment was done, Cavendish and C.J. Phipps went over Burrow's scarcely legible papers from the field.[32] The mean sum of the gravitational attractions on the two sides of the mountain produced an angle of 11.6 seconds, small but large enough to work with.

On the basis of the experiment and Newton's "rules of philosophizing," Maskelyne told the Royal Society in July 1775 that "we are to conclude, that every mountain, and indeed every particle of the Earth, is imbued with the same property [attraction], in proportion to its quantity of matter," and further that the "law of the variation of this force, in the inverse ratio of the squares of the distances, as laid down by Sir Isaac Newton, is also confirmed."[33] For this work, Maskelyne was awarded the Copley Medal in 1775. In his address on the occasion, the president of the Society John Pringle said that the Newtonian system was "finished" and that every man now must become a Newtonian.[34] The quantity the experiment addressed, the mean density of the Earth, had to wait for the calculations of the mathematician Charles Hutton, who had been hired by Maskelyne for the task. In 1778 Hutton finished his paper, some hundred pages of "long and tedious" figuring, arriving at a value for the attraction of the mountain in the north-south direction. To explain why it took him so long, he said that in dividing the mountain into manageable sections and assigning elevations, several thousand triangles had to be calculated, and to find the attraction of the mountain on the plumb line the attractions of around 2000 small parts of the mountain, contained within concentric circles and progressive radii centered on each of the two observational stations, had to be calculated, requiring many hundreds of long divisions in constructing the necessary trigonometric sines. The calculations were an enormous labor, which would have been even far greater if in both cases Cavendish had not proposed laborsaving methods, which Hutton acknowledged. The ratio of the attraction of the Earth to the attraction of the mountain, the quantity sought, was computed two ways. One was a theoretical calculation based on Hutton's configuration of the mountain: by assuming that the density of the mountain is the same as the density of the Earth, the ratio came out to be 9933 to 1. The other was by using Maskelyne's observations of the plumb line, which after making allowance for the centrifugal force of the rotating Earth came out to be 17,804 to 1. The quotient, 17,804 to 9933, approximately 9 to 5, is the quantity by which the mean density of the Earth exceeds that of the mountain. Hutton pointed out that the density of the mountain was unknown, but by assuming that the mountain is "common stone," the density of which is $2\frac{1}{2}$, he deduced that the "mean density of the whole earth is about $4\frac{1}{2}$ the density of water." Newton's best guess was that the density of the Earth is between 5 and 6 ("so much justice was even in the surmises of this wonderful man!"). Reminding his readers that this experiment was the first of its kind, Hutton hoped that it would be repeated in other places.[35]

The experiment on the mountain and the Society's recent concern with the transit of Venus had a common goal: the distance of the Earth from the Sun and the density of the

[32] 6 and 27 Apr. 1775, Minutes of Council, Royal Society 6:267–269.
[33] Nevil Maskelyne (1775b, 532).
[34] John Pringle (1775a); the remark on the Newtonian system comes at the end of the discourse.
[35] Hutton (1778, 689–690, 717, 749–750, 766, 781–783, 785).

Earth were both standard measures of the solar system. At the end of his paper, Hutton related his calculation to the a physical measure of the Sun, Moon, and planets:

> Knowing then the mean density of the Earth in comparison with water, and the densities of all the planets relatively to the Earth, we can now assign the proportions of the densities of all of them as compared to water, after the manner of a common table of specific gravities. And the numbers expressing their relative densities, in respect of water, will be as below, supposing the densities of the planets, as compared to each other, to be as laid down in Mr. de la Lande's astronomy.

Water	1
The Sun	$1\frac{2}{15}$
Mercury	$9\frac{1}{6}$
Venus	$5\frac{11}{15}$
The Earth	$4\frac{1}{2}$
Mars	$3\frac{2}{7}$
The Moon	$3\frac{1}{11}$
Jupiter	$1\frac{1}{14}$
Saturn	$\frac{13}{32}$

Table 10.1: Densities of the Solar System

> Thus then we have brought to a conclusion the computation of this important experiment, and, it is hoped, with no inconsiderable degree of accuracy.[36]

There is a legend that Maskelyne threw a bacchanalian feast for the inhabitants of the region near Schehallien.[37] It is hard to picture the proper Maskelyne taking part in this affair and impossible to picture Cavendish, but Cavendish was not there. Just as he did not travel to observe the transit of Venus, he did not go to Scotland to observe stars from a mountain; he planned the experiment from his study on Great Marlborough Street in London.

A related activity of the Royal Society from which Cavendish likewise stayed home was voyages of discovery, although again he took part in the scientific preparation for them. The world was still incompletely explored by Europeans. In the wake of James Cook's southern voyages, the Royal Society proposed, and the king agreed to, a voyage to the far north, the primary object of which was to settle the practical question of the existence of a shorter route to the East Indies across the North Pole, the hopefully named Northwest Passage. The Society anticipated that such a voyage would also be of service in the "promotion of natural knowledge," the "proper object" of the Society.[38] C.J. Phipps was put in com-

[36]Charles Hutton (1778, 784). B.E. Clotfelter (1987, 211). A second goal of the mountain experiment was to learn about the composition of the interior of the Earth. From the results of the experiment, Hutton concluded that the interior contains great quantities of heavy metals.
[37]Derek Howse (1989, 137–138).
[38]After Daines Barrington, F.R.S., had spoken with the secretary Lord Sandwich, the Council of the Royal Society ordered the secretary of the Society to write to him proposing a northern voyage with practical and scientific ends. 19 Jan. 1773, Minutes of Council, Royal Society 6:160–161.

mand of two frigates, joined by the astronomer Israel Lyons. On this voyage no opportunity for advancing the Royal Society's knowledge of the Earth was overlooked. The president of the Royal Society Joseph Banks provided Phipps with instructions on how to draw up an account of the natural history of the North. From the side of the physical sciences, Phipps and his crew were given multiple assignments, which they carried out while passing through perilous waters, observing a variety of natural objects: refraction of light, height of mountains using a barometer and a theodolite, icebergs, specific gravity of ice, magnetic variation and dip, temperature, pressure, and humidity of the air, and acceleration of a pendulum. They surveyed coasts using a megameter, distilled seawater, compared timekeepers, and made astronomical observations. To improve the art of navigation the Board of Longitude provided Phipps with instruments for experiments. As a member of the Royal Society's committee for this voyage, Cavendish drafted instructions for the use of his father's self-registering thermometer for taking the temperature of the sea at various depths, working out the corrections required to bring the accuracy of the thermometer up to date.[39] Phipps's expedition was a traveling observatory and laboratory of the Earth, or as Cavendish might have pictured it, the Royal Society under sail.

Around the time of Phipps's journey, there was keen interest in the Royal Society in the far north. During the transit of Venus in 1769, the Society sent the astronomer William Bayley to the northernmost projection of Norway, the North Cape. The Society also sent the astronomer and mathematician William Wales, who was a sailing companion of Bayley's, and the astronomer Joseph Dymond to Hudson's Bay in Canada, where they made meteorological as well as astronomical observations of the transit. In 1776, Cook made a journey north, with Bayley aboard, carrying Cavendish's instructions. The same year Richard Pickersgill made a northern journey also carrying Cavendish's instructions.[40]

Beginning in 1773, if not earlier, Cavendish incorporated the Hudson's Bay Company into his network of sources, its northern remoteness affording an opportunity to study nature in a frozen state. In December of that year, as an acknowledgment of its "considerable and repeated benefaction's," the Council of the Royal Society moved to send the Company a collection of meteorological instruments with instructions for its officers to measure the weather and report back to the Society, the secretary of the Society Maty to serve as intermediary.[41] Three days after the motion, Maty wrote to Cavendish to acknowledge his "hints" about observations to be made at Hudson's Bay, and to ask him where the instruments were to be placed in that climate. Because the rain gauge, in particular, could only be used in summer, Maskelyne had proposed that snow be collected on the frozen river, and Maty wanted to know what Cavendish thought about the suggestion.[42] Ten years later Cavendish would carry out researches on the mercury thermometer and on freezing solutions with the aid of personnel of the Hudson's Bay Company. The great trading companies together with

[39] 22 and 29 Apr. 1773, Minutes of Council, Royal Society 6:172–173. The instructions for Phipps's voyage were drawn up by Cavendish, Maskelyne, Horsley, Montaine, and Maty. Charles Richard Weld (1848, 2:72). Henry Cavendish, "Rules for Therm. for Heat of Sea," twenty-four numbered pages with many crossings-out, Cavendish Mss III(a), 7. "To Make the Same Observations on the Flat Ice or Fields of Ice as It Has Been Called," part of a ten-page manuscript, ibid., Misc. There is a second draft of the instructions about ice fields among Cavendish's journals, ibid., X(a). Cavendish's instructions for the use of his father's thermometer are quoted in Constantine John Phipps (1774, 27, 32–33, 142, 145).
[40] Cavendish Mss IX, 41, 43.
[41] 23 Dec. 1773 and 20 Jan. 1774, Minutes of Council, Royal Society 6:205, 208.
[42] Matthew Maty to Henry Cavendish, 26 Dec. 1773; in Jungnickel and McCormmach (1999, 541–542).

the admiralty were, in effect, a part of the method of science in eighteenth-century Britain. Cavendish received observations from voyages around the world.[43]

One of Cavendish's close colleagues in the Royal Society was a professional voyager, the first hydrographer for the East India Company and later the first hydrographer for the admiralty, Alexander Dalrymple (Fig. 12.2). A man of great energy and versatility, Dalrymple was an explorer, chart maker, navigator, surveyor, commander, geographer, author of the first English book on nautical surveying, and the moving spirit behind the "second British Empire." His hypotheses inspired major voyages of discovery to test them. Thoroughly scientific in his approach to oceanic exploration, he had a keen interest in scientific instruments, especially chronometers. He was stubborn, difficult to work with, short tempered, and he has said of himself, "humour was not his talent!" It is unlikely that Cavendish was distracted by these traits, appreciating Dalrymple's insistence on "accurate precision," his constant "investigation of Hydrographic Truth, amidst the variety of discordant authorities," and his "unstinting [...] loyalty towards those who have earned his confidence."[44] Warmly greeted by Dalrymple in letters, Cavendish named him a trustee of his property, left him a legacy in his will, and repeatedly lent him money.[45] Cavendish no doubt thought he was amply rewarded in the news of the world that Dalrymple regularly brought him.

Voyagers held a special interest for Cavendish, who invited them as his guest at the Royal Society and the Royal Society Club. In the certificates book of the Society we find that he recommended at least ten men who were known for their wide travels as well as their learning. One of them was the ship's captain James Horsburgh, who like Dalrymple would be appointed hydrographer to the East India Company. Dalrymple met Horsburgh in London, where he introduced him to Cavendish and other men of science in 1801. From Bombay in 1805, Horsburgh sent Cavendish a paper on meteorological readings to communicate to the Royal Society. That year Dalrymple asked Cavendish, Maskelyne, and Aubert to join him in recommending Horsburgh as a fellow, as they did, only Aubert did not sign the certificate since he died that year.[46] Other world travelers recommended by Cavendish included Josias Dupré, who as secretary for the East India Company at Fort St. George at Madras had appointed Dalrymple as his deputy, preparing the way for the latter's career; Robert Barker, a Member of Parliament, who formerly was in the service of the East India Company as "Commander in Chief in Bengal, being curious in natural History";[47] Samuel Davis, "of Bhagalpur in the East Indies," who as a civil servant in Benares was an active member of the Asiatic Society, publishing in its journal on the "astronomical computation of the Hindus"; James Cook, who was the "successful conductor of two important voyages for the discovery of unknown countries by which geography & natural history have been greatly advantaged & improved"; James King, who was "Captain in the Royal Navy, lately

[43]Robert Barker (1775). Alexander Dalrymple (1778). Dalrymple took observations with thermometers, barometers, and a dipping needle, and in his report he gave a long extract on the latter instrument by Cavendish (390).

[44]W.A. Spray (1970, 200–201). Howard T. Fry (1970, xiii–xvi, xx–xxi, 235).

[45]Cavendish loaned Dalrymple £500 in each of several years, 1783, 1799, 1800, and 1807. Dalrymple needed money to pay debts due immediately. Upon his death, his administrator asked Cavendish to tell him how much was owed him. The matter was still pending a few years later when Cavendish died. "27 December 1811 Principal Money and Interest This Day Received of Alex. Dalrymple Esq. Exctr. £ 2873.3.5," Devon. Coll., L/31/64 and 34/64.

[46]James Horsburgh (1805). "Horsburgh, James," *DNB*, 1st ed. 9:1270–71. Fry (1970, 253–255). Certificates, Royal Society 6: James Horsburgh (proposed 21 Nov. 1805).

[47]Certificates, Royal Society 3:209, Robert Barker (proposed 15 Dec. 1774); ibid. 4:23, Josias Dupré (proposed 25 Feb. 1779). "Barker, Sir Robert," *DNB*, 1st ed. 1:1128–29.

returned from a Voyage of Discoveries in the South Seas"; Isaac Titsingh, who was "long resident in various parts of the East, particularly Japan, skilled in various branches of natural knowledge"; William Bligh, who was "Post Captain in H.M.'s Navy […] whose Voyages to the Pacific Ocean have established his character as an able Navigator, whilst they enriched our Westindian Colonies with the most valuable productions of the South Sea Island"; John Thomas Stanley, "who has lately made a voyage to Iceland for the improvement of natural knowledge"; and John Hunter, Cavendish's personal physician who had recently returned from Jamaica, where he served as superintendent of military hospitals, and was soon to bring out his book on the diseases of the army in Jamaica.[48] These widely traveled men Cavendish recommended as members of the Royal Society over a period of thirty years, evidence that he wanted the Society not to be limited to people like himself, Londoners who rarely left town. He welcomed as members men who had direct experience of the wider world, counteracting parochial tendencies, and insuring a vigorous scientific life in the metropolis.

Figure 10.4: Royal Society. Painting by Frederick William Fairholt, engraving by H. Melville. This is the meeting room of the Royal Society at Somerset House 1780–1857. Over the last thirty years of his life, Cavendish came regularly to meetings here. The president of the Society is at the center, and the two secretaries at either side. The paintings on the wall are of past distinguished members. Reproduced by permission of the President and Council of the Royal Society. Wikimedia Commons.

[48]Certificates, Royal Society 3:237, James Cook (proposed 23 Nov. 1775); ibid. 4:56, James King (proposed 23 Nov. 1780); ibid. 5, John Hunter (elected 12 Jan. 1786); ibid. 5, John Thomas Stanley (elected 29 Apr. 1790); ibid. 5, Samuel Davis (elected 28 June 1792); ibid. 5, Isaac Titsingh (elected 22 June 1797); ibid. 6, William Bligh (elected 19 Feb. 1801).

The meeting place of the Royal Society at Crane Court was cramped, and when Joseph Banks became president in 1778, he approached the government for ampler quarters, a prospect which the Society had been considering for some years. Cavendish was appointed to a committee to meet with the architect about fitting up apartments in the new home of the Society, Somerset House (Fig. 10.4). Having examined the meteorological instruments of the Society a few years before and advising on their use at Crane Court, he was charged with their relocation.[49] In his report to the Council he was particularly concerned with the "error" of a thermometer, which he proposed setting some feet away from the sunlit wall, hardly "any eye sore," though he preferred a window of the room where the Society of Antiquaries met, if they would permit it.[50] Subsequently, he was appointed to a committee to oversee the meteorological journal at the Society's new home.[51] Although it was not exactly spacious, Somerset House had more room, and it was better located than Crane Court.[52] In the meeting room, the president sat on a high-backed chair, looking like a judge, well above the table at which the secretaries sat, while the ordinary members sat on benches with rail backs resembling pews. For the last thirty years of his life, Cavendish came regularly to this meeting room, where he sat beneath paintings of illustrious past members, crammed on the walls one above another. (By refusing to sit for a painting, he ensured that he would not be exhibited on those walls exposed to the eyes of strangers.) The next move of the Society was not until 1857, when its new home was Burlington House in Piccadilly, which had belonged to the Cavendishes.

In a manuscript in the British Library, an anonymously reported fragment of conversation reads, "Mr. Cavendish rather wished to have the Presidentship." This follows immediately after fragments attributed to Aubert and Smeaton, evidently part of the same conversation: "Aubert asked Russell how his mercantile character would be affected by being a Candidate for the Presidentship of the Royal Society. Smeaton said he should vote for him."[53] The subject dates the conversation. When in 1778 the president of the Royal Society Pringle resigned, Aubert was one of two candidates picked to replace him, the other being Banks. Because of his shyness, it seems unlikely that Cavendish would ever have wanted to be president, and at first we discounted the gossip, but it is not inconceivable. He worked with members of the Council constantly; he served on committees, sometimes heading them; and on occasion he presided over meetings. Somebody must have heard Cavendish express the desire to be president or heard someone who heard him, unless it was a joke. In his scientific work, Cavendish followed his father and went beyond him, and in his service to the Society, he followed his father again. Charles Cavendish had declined entreaties to become president, and perhaps Henry was prepared to go beyond his father in this way too. Perhaps he was also inspired by Newton, who was an energetic and conscientious president of the Royal Society. Serious about the scientific content of the meetings of the Royal Society, when Newton presided there was no laughter or inattentive whispering. Called a "grand administrator of science" and scientifically preeminent, Newton was in

[49] 16 Mar., 6 July 1781, Minutes of Council, Royal Society 6:397, 439.
[50] 2 Aug. 1781, ibid. 6:440–442: "A Report from Mr. Cavendish Concerning the Meteorological Apparatus." The Society's concern with placing the meteorological instruments continued, leading to a committee formed of Cavendish, Aubert, Heberden, Deluc, Watson and Francis Wollaston: 12 Feb. 1784, ibid. 7:62.
[51] 19 Jan. 1786, Minutes of Council, Royal Society 7:138. This committee consisted of Cavendish, Chambers, Aubert, Kirwan, and Shuckburgh.
[52] D.C. Martin (1967, 16).
[53] "Notes of Conversations 1770–1790," BL Add Mss 35,258, f. 15.

these ways probably Cavendish's idea of a good president.[54] The Royal Society was by far the most important body in Cavendish's life just as natural philosophy was by far his most important work; it may have seemed natural to him to serve as its able president.

British Museum

In 1773 Cavendish joined his father as a trustee of the British Museum.[55] During his tenure, general meetings of the trustees were held two to five times a year, occasionally as many as six or seven, with attendance averaging about eight to ten, but often not enough for a quorum. The few other trustees who attended frequently were the Cavendishes and their acquaintances from the Royal Society and their relatives: Banks, Wray, Watson, Pringle, Yorke (now Lord Hardwicke), and Lord Bessborough.[56] The standing committee of the trustees took care of most of the business and prepared reports for the general meetings. The committee, which in effect was any trustees who cared to attend, met weekly until the 1780s, then fortnightly, and eventually monthly.[57] For ten years Cavendish came regularly to the meetings of the committee with his father, a commitment which was both substantial and unusual, since rarely as many as six attended the meetings. Those who came were usually the same as those who came to the general meetings.

The standing committee had a wide range of responsibilities, mostly having to do with routine matters, such as paying bills and performing audits, but there was also an unpredictable element. The committee routinely gave permission for visitors to copy documents and draw birds but also, on occasion, to examine human monsters under the inspection of an officer of the Museum. It heard standard complaints about the cold of the medals room and the damp of the reading room, but it also heard about the infighting of the staff, whom the committee ordered to stop quarreling and be amicable.[58] It laid out money to buy or to subscribe to important works of science for the library such as Robert Smith's *System of Opticks* and Samuel Horsley's edition of Newton's works.[59] It noted gifts of books and collectibles. Just before Cavendish was elected a trustee, John Walsh and John Hunter presented two specimens of the electric eel,[60] and two years later, just as Cavendish was beginning his experiments on an artificial electric eel, Walsh presented another electric eel whose organs had been laid open by Hunter, who presented a transverse section of an electric eel.[61] Occasionally gifts were substantial: in 1773 Banks presented his large collection of Icelandic sagas, and Lord Rockingham presented his large collection of animals preserved in spirit in seventy-two glasses, to which he added more glasses the next year. Most gifts, however,

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[54] Richard S. Westfall (1980, 630, 634–635). Frank E. Manuel (1968, 266, 281). The domineering side of Newton probably would not have been Cavendish's preference.

[55] Cavendish was elected trustee on 8 Dec. 1773. Minutes of the General Meeting of the Trustees, vol. 3. His record of attendance over the years is in the Minutes of the British Museum: Committee, vols. 5 to 9; General Meeting, vols. 3 to 5.

[56] Sometimes he attended all of the meetings, but often he came to only some. What was for him a less than exemplary attendance no doubt owed to the largely formal nature of its proceedings.

[57] P.R. Harris (1998, 11).

[58] The order for amicable relations was made on 9 May 1777. Committee Minutes of the British Museum, BL, 6.

[59] 31 July and 11 Sep. 1778, ibid.

[60] 23 Apr. 1773, ibid., vol. 5.

[61] Walsh's gift was in January or February 1775, and Hunter's was on 16 June 1775, Diary and Occurrence-Book of the British Museum, BL Add Mss 45875, 6.

were isolated curiosities of the sort that were written about in the *Philosophical Transactions*, a six-legged pig, a frog preserved in amber, the head of a seahorse, and, presented by Charles Cavendish, a "curious Specimen of a double Egg."[62] Stuffed birds from the Cape of Good Hope, serpents from the East Indies, shells from Labrador, insects from Jamaica, a gun and powderhorn from Bengal, Captain Cook's artificial curiosities from the South Sea islands, and much more from Britain's colonial extremities and seafaring way of life piled up in the British Museum. First Charles Cavendish, then Charles and Henry together, and then Henry gave conscientious attention to the affairs of the British Museum for over fifty years. Through this central, public institution for books and collections, they served the public and the cause of learning.

Society of Antiquaries

In the same year that he became a trustee of the British Museum, 1773, Cavendish was elected a fellow of the Society of Antiquaries of London. Described as a gentleman of "great Abilities, & extensive knowledge," but with no mention of any accomplishments in antiquarian scholarship, Cavendish was recommended by Heberden, Wray, Burrow, Colebrook, Barrington, and Jean Louis Petit, all of whom were also members of the Royal Society.[63] Macclesfield, Banks, Birch, and other colleagues of Cavendish's from the Royal Society were also members, indicative of the overlap in membership of the two societies.[64]

Originating with a group who met in a coffee house to discuss history and genealogy, the Society of Antiquaries was formally created, or re-created, in 1717. The leading spirit of the Society in its early years was the physician William Stukeley, a productive antiquarian, known as the "Archdruid of this age,"[65] who was also a prominent member of the Royal Society. Early on there was an attempt to merge the Antiquarian Society and the Royal Society, but the stronger desire was for separateness and equality. In 1751 Martin Folkes, who was at the same time president of the Society of Antiquaries and president of the Royal Society, pushed through a reform to establish a Council and officers for the Society of Antiquaries in imitation of those for the Royal Society, and in that year the Society was granted a royal charter.[66] In other ways too, it imitated the Royal Society, acquiring a dining club, a journal, and a committee of papers. Fellows of the Royal Society, it would seem, sometimes acted in concert in the politics of the other society, and it no doubt worked the other way too.[67] A large proportion of the officers and Council of the Society of Antiquaries were fellows of the Royal Society. At the time the Society of Antiquaries received its charter, a member wishing to make public new discoveries in antiquities might consider doing so through either the Royal Society or the Society of Antiquaries. Francis Drake, F.R.S. and F.S.A., told Charles Lyttleton, F.R.S. and future president of the Society of Antiquaries, that he had

[62] Meeting on 13 Sep. 1776, Committee Minutes of the British Museum, BL, 6.
[63] Cavendish was proposed on 21 Jan. 1773 and elected on 25 Feb. 1773; on 18 Mar. he paid his admission fee and was admitted to the Society. Minute Book, Society of Antiquaries, 12:53, 580, 610.
[64] Of the twenty-one members of the Council of the Society of Antiquaries in 1760, eleven , including the president, were also fellows of the Royal Society, and of its ordinary membership forty-six were fellows of the Royal Society. "A List of the Society of Antiquaries of London, Apr. 23, MDCCLX," BL, Edgerton 2381, ff. 172–175.
[65] "William Stukeley, M.D.," in William Munk (1878, 74).
[66] Joan Evans (1956, 442).
[67] Peter Davall to Thomas Birch, 22 Apr. 1754, BL Add Mss 4304, vol. 5, f. 126. Daniel Wray to Thomas Birch, 7 Mar. 1753, BL Add Mss 4322, f. 111.

had better success communicating discoveries of antiquities to the Royal Society than to the Society of Antiquaries, and that he was inclined to follow that guide with his present subject, a Roman alter, as he did, publishing his paper in the *Philosophical Transactions*.[68] James Burrow, F.R.S. and F.S.A., sent a paper to Thomas Birch, F.R.S. and F.S.A., saying that he always intended it for the Society of Antiquaries and "never entertained the least thought of communicating it to the Royal Society, since it cannot pretend to be of any use towards the advancement of *natural* knowledge," but because of an opinion of the committee of papers, he was sending it to the Royal Society after all.[69] The division between topics belonging to the Royal Society and those belonging to the antiquaries was evidently clear in principle to Burrow, but in practice it was not sharply drawn. The Society of Antiquaries also had interests in common with the British Museum, an institution which drew support from the "antiquarian milieu."[70]

The duty of the Society of Antiquaries was to record "Antient Monuments," such as cities, roads, churches, statues, tombs, utensils, medals, deeds, letters, and whatever other ruins and writings belonged to the "History of Brittish Antiquitys."[71] The meaning to be derived from such objects was a matter of judgment and strong feeling. When Cavendish joined the Society, its minutes recorded long papers, which revealed contemporary views on the direction of the field. There was, for instance, a paper on the history of Manchester, written on a "rational plan," which promised to rise above the parochialism of the usual town histories to illuminate the "general polity" of towns and the "general antiquities" of the entire kingdom and to lay open the causes and circumstances of "any momentous events" affecting Manchester. Antiquaries could condemn antiquarianism in the pejorative meaning of the term.[72] Other papers from this time made a moral point; for example, a history of cockfighting corrected the "errors" of the modern writers, but its main purpose was to show the perversion of cockfighting from a religious and political institution for instilling valor to the present day pastime founded on cruelty, finding it offensive to humanity that "rational & civiliz'd minds" could take enjoyment in this spectacle.[73]

In 1770 the Society of Antiquaries introduced its own journal, *Archaeologia*, an occasion for a forceful statement of the purpose of the Society by its director Richard Gough. The chartered antiquaries have as their object not their "own entertainment" but the communication of their "researches to the public." Belonging to the modern "age wherein every part of science is advancing to perfection," antiquaries had a duty to make proper use of their facts: "*history*" was not a poetic narrative but a "regular" inquiry into the records and proofs of the past.[74] Apart from their common objectives, "science," "knowledge," and "truth," and their common membership, the Society of Antiquaries and the Royal Society had common work. Because science had its own antiquities, both societies had a concern with the history

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[68] Francis Drake to Charles Lyttleton, 26 Jan. 1756, Correspondence of C. Lyttleton, BL, Stowe Mss 753, ff. 288–89.
[69] The Royal Society's committee of papers sent Burrow's paper to the secretary of the Royal Society, having drawn red lines through the passages that Burrow had expressly addressed to the Society of Antiquaries. James Burrow to Thomas Birch, 18 June 1762, Birch Correspondence, BL Add Mss 4301, vol. 2, 363.
[70] David Philip Miller (1981, 46).
[71] In Stukeley's hand, in the first Minute Book of the Society, quoted in Evans (1956, 58).
[72] John Whitaker, "The History of Manchester," 6 Dec. 1770, Minute Book, Society of Antiquaries, 11.
[73] Samuel Pegge, "A Memoir on Cockfighting: wherein the Antiquity of It, as a Pastime, Is Examined & Stated; Some Errors of the Moderns Concerning It Are Corrected; & the Retention of It amongst Christians Absolutely Condemned & Proscribed," 11, 12 and 19 March 1772, Minute Book, Royal Society of Antiquaries, 11.
[74] Richard Gough on the purpose of the Society of Antiquaries' publication, in vol. 1, 1770, of *Archaeologia*.

and biography of science.[75] History and natural history were both collecting activities,[76] and history and astronomy were both dating activities, ensuring a lively interaction between these fields at times.[77] Antiquaries were interested in views of Pompeii and the like, and there was interest in the Gothic as well is in the Classic, but there was also interest in contemporary history, so strongly marked by science and technology; an example was a history of the Society of Arts, to which Charles and Henry Cavendish belonged.[78]

Cavendish became a member of the Society of Antiquaries at a time when the membership was rapidly growing, having nearly doubled in the ten years before his election.[79] Many of the new members came from the upper classes, including the nobility. Many also came from science: in the same year as Cavendish, Franklin and Pringle were elected. There is the suggestion that both wealthy and learned persons entered the Society to receive its new journal, *Archaeologia*.[80] Cavendish took considerable interest in papers in that journal having to do with India; his own paper on the Hindu calendar fitted either it or the *Philosophical Transactions*, which was where he published it.

Cavendish's membership in the Society of Antiquaries together with his membership in the Royal Society and his trusteeship in the British Museum was inscribed on the plate of his coffin, but to Cavendish the affiliations were not of equal importance. He applied himself to the affairs of the Royal Society and of the British Museum, whereas he took no responsibilities in the Society of Antiquaries. He entered the record only once and then as an intermediary, submitting drawings of an Indian pagoda in the name of his scientific colleague Alexander Dalrymple.[81]

There was a plan to bring together in the same meeting place the Society of Antiquaries, the Royal Society, the British Museum, and the Royal Academy of Painting, Sculpture and Architecture. It was only partly to be realized. In 1753 the Society of Antiquaries took over a former coffeehouse on Chancery Lane, and the British Museum moved into Montague house the following year. Twenty years later, the Royal Society began planning its apartments for its new location, Somerset House. Cavendish, who was much involved with that move, agreed with others on the Council that it would be a "great inconvenience" for the Royal Society to have any apartments in common with the Society of Antiquaries, or even

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[75] There are many letters from members of the Royal Society to John Ward, president of the Society of Antiquaries, professor of rhetoric at Gresham College, and F.R.S. He published frequently on antiquities in the *Philosophical Transactions*. He helped locate letters of the chemist Robert Boyle for the benefit of the Royal Society: Henry Miles, F.R.S., to John Ward, 10 Feb. 1742/41 and 13 June 1746, Letters of Learned Men to Professor Ward, BL Add Mss 6210, ff. 248–50.

[76] In connection with a natural history of fossils, Emanuel Mendes da Costa wrote to John Ward to ask if certain Roman vases were made of marble or porcelain. Letter of 13 Nov. 1754, Letters of Learned Men to Professor Ward.

[77] Concerned with Homer's placement of Troy, John Machin wrote to John Ward: "My whole time has been employed in tedious and irksome calculations to adjust and settle the moons mean motion, in order to make a proper use of the eclipse at the death of Patroculus." 23 Oct. 1745, ibid., ff, 230–231.

[78] This "history of the rise and progress of the Society for the Encouragement of Arts, Manufactures & Sciences" was read at the meetings of 1 and 8 June 1758. The paper was kept in a folio with the purpose of entering "occurrences of our own time." Emanuel da Costa, "Minutes of the Royal Society and the Society of Antiquaries," BL, Edgerton Mss 2381, ff. 57–58.

[79] Membership was 173 in 1764 and 290 in 1774. Evans (1956, 148).

[80] Between 1770 and 1775, sixteen upper-class members, including Cavendish, were elected. Ibid., 150.

[81] Henry Cavendish to William Norris, undated. This letter, which is in the library of the Society of Antiquaries, has to do with an extract by Alexander Dalrymple from a journal in the possession of the East India Company, evidently referring to an "Account of a Curious Pagoda near Bombay …," drawn up by Captain Pyke in 1712, and communicated to the Society of Antiquaries on 10 Feb. 1780 by Dalrymple; published in *Archaeologia* 7 (1785): 323–332.

a common staircase. The public apartments of the Royal Society "will be understood by all Europe, as meant to confer on them an external splendor, in some measure proportioned to the consideration in which they have been held for more than a century."[82] A week later the architect William Chambers informed the Royal Society that its wish could not be met: no space could be allotted to the Royal Society consistent with its "splendor" other than what it had in common with the Society of Antiquaries. Their common location said nothing about their interests, which were becoming more differentiated.[83]

[82] 10 May 1776, Minutes of Council, Royal Society 6:302–303.
[83] 18 May 1776, ibid., 304–306. Evans (1956, 152).