the very least he was more than commonly misanthropic. As both Bernstein and Hoffmann suggest, Einstein was not "very much with people." Perhaps what Einstein's life tells us is that the ultimate celebration of humanity is not being "very much with people" but rather being very much a person.

Hoffmann's book is very well illustrated with drawings and photographs. His final illustration, a Herblock cartoon done at the time of Einstein's death, perhaps best reflects the kind of intuition that Einstein himself had revealed in the course of his active life. The cartoon depicts the earth, lost in the immensity of the universe, with a sign on it, "Albert Einstein lived here."

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The Dissemination of Newtonianism

Newton and Russia. The Early Influence, 1698–1796. VALENTIN Boss. Harvard University Press, Cambridge, Mass., 1972. xviii, 310 pp. + plates. $19. Russian Research Center Studies, 69.

Historians of science concerned with the spread of Newton's thought have concentrated upon western Europe and have paid little attention to its introduction into central and eastern Europe. In this book, the first detailed study to be published on the subject, Valentin Boss examines the historical beginnings of the influence of Newton in Russia.

Boss delineates well the transmission of the core of Newton's natural philosophy to Russia and the reaction to it there. For him this core consists of Newton's doctrines in mechanics, optics and light, and mathematics. The mathematics he refers to is not the synthetic geometry of the *Principia* but the method of fluxions, the embryonic form of the calculus. His book, which is basically an intellectual history, contains a wealth of information. It is divided into two main sections. The first probes the scientific work of Jacob Daniel (Iakov Vilimovich) Bruce, a confidant of Peter the Great; the second concentrates upon the major polemics and selected, pertinent research at the St. Petersburg Academy of Sciences from 1725 to 1765.

Boss demonstrates that Bruce played a major role in introducing Newton's thought into Russia. Bruce, who met Newton in 1698, acted as a publicist and translator at the Russian court. He participated in scientific discussions at meetings of a small group in Moscow called the "Society of Neptune" and in 1717 translated into Russian Huygens's *Kosmotheoros*, which became the first book in the Russian language to describe the Newtonian cosmology with its law of universal gravitation (attraction). Unfortunately, the printer, an Old Believer who considered the book atheistic, sabotaged its publication, and as a result only 30 copies of the first edition were printed.

Through the preparation of a catalog of Bruce's library, Boss has further found that Bruce collected all the major writings of and more important commentaries on Newton. After Bruce's death in 1736, his library was acquired by the St. Petersburg Academy of Sciences. In this period formal training in science and mathematics scarcely existed in Russia, and in the absence of established universities the St. Petersburg Academy, founded in 1725/26, was the chief scientific institution. It was through the academy that Newton's thought was originally developed and disseminated in Russia.

The early St. Petersburg Academy was a European, not strictly a Russian, institution. Its initial members were German, Swiss, and French. They knew Cartesian, Leibnizian, Wolffian, and Newtonian scientific thought. Boss describes their responses to Newton's thought as represented in the *Commentarii*, the journal of the academy, and the correspondence and other publications of the academicians. In the process he shows that they conducted some sound and substantial research in the physical sciences.

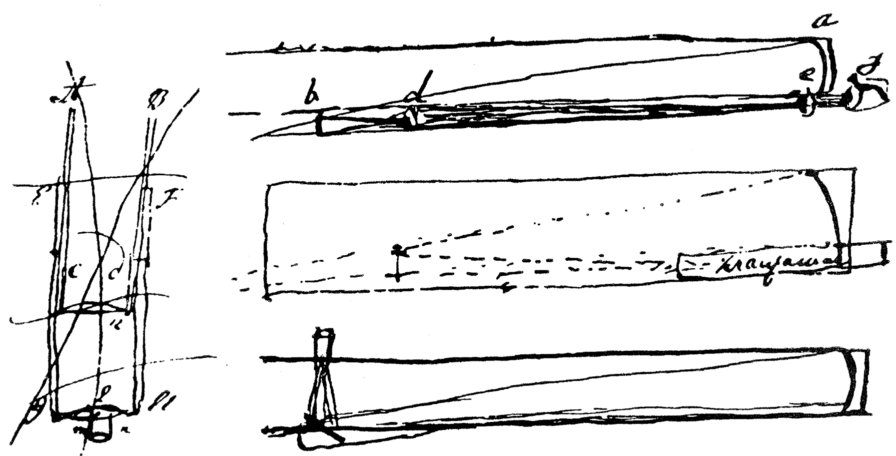
Boss relates that Newton's natural philosophy aroused acrimonious debate and found little support at the academy initially. During the late 1720's the Wolffian leaders Georg Bilfinger and Jacob Hermann criticized Newton's concept of attraction, while Daniel Bernoulli and, from England, James Jurin, the secretary of the Royal Society, defended it. From 1725 until 1737 the academicians debated whether the true shape of the earth was the Cartesian oblong configuration or the Newtonian sphere with a flattening at the poles. The Paris Academy's Lapland expedition (1736–1737), which they closely followed, confirmed the Newtonian position and ended this debate.

After the departure of Bernoulli from Russia in 1733 Cartesian ideas persisted among the St. Petersburg academicians, and for a time they fell silent on Newton's thought. Late in the 1730's the Russian poet and philosophe Antiokh Cantemir came to the support of Newtonianism. He sent the academy copies of Newton's writings and commentaries and science journals from England and France. He also unsuccessfully attempted to have published a Russian translation of the Italian Newtonian Francesco Algarotti's *Il Newtonianismo per la dame* (1737).

According to Boss, Leonhard Euler, the foremost academician from 1734 until 1741, largely determined the scientific views held by the academy at the end of the 1730's. This appears to be correct. Boss, however, seems to exaggerate Euler's power to enforce his views among his colleagues. Furthermore, his depiction of Euler as a Cartesian hostile to Newton is a dubious one.

Recently the physicist Clifford Truesdell and the historian Eduard Winter have discredited the notion that Euler was purely and exclusively a Cartesian (*1*). They have shown him, rather, to be an eclectic. An analysis of Euler's *Mechanica* (1736), which is missing in this book, could have revealed this. Boss, however, is on solid ground when he states that at this time Euler opposed Newton's corpuscular theory of light and the concept of attraction, which he apparently did not accept until 1744. Correspondence of the time and academy records substantiate his vociferous opposition to segments of Newton's thought before his departure from Russia in 1741.

From his investigation of the Richmann-Weitbrecht dispute (1744–1745) over the validity of the Leibnizian doctrine of the conservation of "vis viva" (mv^2) and the academy's research on the nature of light and electricity, Boss discerns that Newton's ideas gained considerable attention and received less criticism at the academy during the 1740's and 1750's. Indeed a Newtonian triumph occurred in 1759 when the academician Franz Aepinus published in St. Petersburg his *Tentamen theoriae electricitatis et magnetismi*, which was



Drawings by Michael Lomonosov for his telescopes. (Left) The telescope referred to by Lomonosov as "Newtoniano-Gregor.-Lomon. tubus" and "speculum ex Newtoniano, Gregoriano et meo composium." The drawings show (top) the inclination of the speculum and the position of the eyepiece and (middle) the path of light; at the bottom is Lomonosov's initial sketch with the eyepiece in the same position as in Newton's reflector telescope. (Right) The "tubus nyctopticus modo Lomonosov-Newton," indicating a return to the refracting principle. [From *Newton and Russia: The Early Influence, 1698–1796*]

an important exposition of electrical phenomena based upon attraction (action at a distance).

The academy was not, however, without a prominent critic of Newton's natural philosophy during these decades. As Boss recounts in detail, the Russian chemist and poet Michael V. Lomonosov, who in large measure accepted the scientific views of his teacher Christian Wolff, opposed Newton's empirical methodology, atomism, attraction, and the corpuscular theory of light. Boss notes, however, that Lomonosov did continue the work of Newton in one regard, attempting, unsuccessfully, to improve upon Newton's telescope for use at night and in conditions of poor visibility.

In order to elucidate the scientific outlook of Lomonosov, Boss surveys part of Wolff's scientific philosophy, which he disparages. Indeed he dismisses Wolffian criticisms of Newton as "prejudices." This analysis is inadequate (*2*). Boss does not probe the major source for Wolffian scientific thought, the Leibnizian natural philosophy, which had as its components the calculus, analytical mechanics, monadism with its projected physical continuum, and an organismic view of the universe. Although his criticism of Wolff's purely rationalistic methodology and search for metaphysical explanations of physical causes has some merit, his criticism of Leibniz's and Wolff's mathematics, especially their formalism, the strict appeal to the algorithmic nature of method, is open to question. Formalism along with intuitionism and logicism has been important in the development of modern mathematics. Boss holds that the progress of modern physics was due in large part to Newton's method of fluxions. But early in the 18th century Continental mathematicians and theoretical physicists looked for guidance to the differential calculus of Leibniz, Wolff, and the Bernoullis and by mid-century to Euler's (not Newton's) mathematical analysis, which combined the differential calculus and the method of fluxions into one general system.

Boss believes that the St. Petersburg academicians came to accept the core of Newton's natural philosophy beginning about 1757, when Lomonosov failed to generate opposition to Newton's definition of weight as stated in the *Principia*. On the basis of the information presented in this book, this conclusion is sound, especially since the author observes that the academicians did not accept Newton in toto but continued to question his optics.

Euler, who returned to Russia in 1766, is portrayed as continuing to oppose Newton in general, and therefore as being an exception at the academy at this time. This characterization is based upon an interpretation of Euler's *Letters to a German Princess* (three volumes, 1768–1772), which Boss maintains were "critical and hostile" toward Newton. On p. 215 Boss quotes from a letter criticizing Newton's explanation of the illumination of opaque bodies and implies that this passage refers to all of Newton's thought, which it does not. A careful reading of the *Letters* would have revealed the following statement: "The Newtonian system . . . made at first a great noise, and with good reason, as no one had hitherto hit upon a discovery so very fortunate, and which diffused at once such clear light over every branch of science" (*3*, p. 188). Moreover, there is reference to the law of universal gravitation as an "incontestable fact" (*3*, p. 191). In fact, Euler, like his fellow academicians, supported Newton's mechanics and the calculus but opposed the corpuscular theory of light. In part, the *Letters* are an exposition of Newton's ideas.

During the Catherinian era (1762–1796) Newton's ideas spread beyond the confines of the St. Petersburg Academy to the growing educated public in Russia. Boss cites contemporary journal articles and correspondence to confirm this. Catherine herself aided the popularization by encouraging the translation into Russian of Voltaire's writings and by inviting Diderot to St. Petersburg. The Russian author Nicholas Kurganov's publication *Pismovnik* (1769; second edition, 1777; third edition, 1796), a popular, encyclopedic work, and a Russian translation of Pope's *Essay on Man* also offered readers a partial view of Newton.

Apart from the treatment given Euler and Wolff, there is little to criticize in this book. The research for it has been thorough. There are only a few errors in dates and biographical information. At times one does find a tendency toward overstatement. An example of this occurs in the useful "bibliographic note" section of the book. Although the bibliography is extensive, it does not, as stated, cover *all* sources of information on Newton's early influence in Russia. For example, the writings cited in (*1*) and (*2*) of this review are not included there.

Boss has not only made a major contribution to our knowledge of the influence of Newton's thought in the 18th century but has also demonstrated the importance of the St. Petersburg Academy as a center for scientific research at that time. Moreover, his book points out directions and areas for new, specialized studies in the history of the physical sciences in Russia. It also suggests that a similar study dealing with the German-speaking areas of Europe would be useful.

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References

1. See C. Truesdell, *Essays in the History of Mechanics* (Springer-Verlag, New York, 1968), and E. Winter, Ed., *Die Deutsch-russische Begegnung und Leonhard Euler* (Akademie-Verlag, Berlin, 1958).
2. For another view of Wolff see R. S. Calinger, "The Newtonian-Wolffian confrontation in the St. Petersburg Academy of Sciences (1725–46)," *J. World His.* **11** (3), 417–36 (1968).
3. L. Euler, *Letters of Euler on Different Subjects in Natural Philosophy Addressed to a German Princess*, notes by D. Brewster (Harper, New York, 1840), vol. 1.

Unsimple Views of Science

Science, Medicine and Society in the Renaissance. Essays to Honor Walter Pagel. ALLEN G. DEBUS, Ed. Science History (Neale Watson Academic) Publications, New York, 1973. Two volumes, boxed. vi, 276 pp., and vi, 338 pp., illus. $50; prepaid, $35.

Today one scarcely need make the point that a revolution is under way in our understanding of science. Whether one's concern lies in the history, the sociology, or the philosophy of science; whether one's interest lies in the social relations of science or in the possible linkages between science, technology, and environmental and ecological change; or whether one's most immediate problem is with obtaining continuing funds for one's own scientific research—in every case the shifting cultural valuation of science is immediately obvious. The dimensions of the shift become starkly apparent if one turns back to the later Victorians.

Few could now agree with E. Ray Lankester's 1883 claim to the British Association for the Advancement of Science that "there is no greater good than the increase of science . . . through it all other good will follow." Likewise, few would accept R. H. Thurston's statement to the AAAS in the following year that science is "a spiritual agent, promoting morality" or that "it has generated 'sweetness and light.'" It is therefore salutory to be reminded that as late as 1927 George Sarton could claim with the utmost seriousness that "the history of science is the history of mankind's unity, of its sublime purpose, of its gradual redemption." Today it is hard for us to make the imaginative leap necessary to recapture such simple faith. Yet late Victorian and Edwardian patterns of thought still underlie much of our discussion of the scientific enterprise. To dissolve those patterns and replace them with less simplistic approaches is the common task of contemporary analysts of science. And among that particular subset of analysts known as historians none has been more wholehearted or influential in this task than Walter Pagel. The appearance of a handsome two-volume festschrift to celebrate his 75th birthday thus offers an opportunity to examine at least one facet of our changing perceptions of the nature of science.

Walter Pagel, the son of the eminent German historian of medicine Julius Pagel (1851–1912), graduated M.D. at Berlin in 1922. The greater part of his professional life has been spent as a practicing pathologist in England (first in Cambridgeshire, then in London). Yet well before he was 30 he had begun that second career in the history of science and medicine for which he is best known. From 1933 to 1939 he found time to serve as founding secretary of the History of Science Lectures Committee of Cambridge University. He thus played a critical role in helping to stimulate interest in, and define the standards of, the emerging academic discipline of the history of science. But Pagel's major impact is in his writing. Over the last half century he has put out more than 400 books, articles, and reviews—written in three different countries, often under difficult conditions and, since 1933, without benefit of any regular university position. His writings have transformed our understanding of the roots of modern science.

In large part because of Pagel's work (notably aided by the somewhat differently inspired researches of D. P. Walker and Frances Yates), it is no longer possible to see modern science as simply the heroic creation of a series of workers in technical physics and astronomy. Pagel has plainly demonstrated the influence on the 17th-century mind of Paracelsus and Van Helmont. Through this demonstration he has highlighted the importance of philosophic, mystical, and religious motives in the quest for an ordered understanding of nature. In emphasizing the debt of William Harvey to Aristotelian modes of thought he has illustrated the futility of any simple dichotomy between ancients and moderns. Above all, Pagel's prolific writings have revealed the complexity and variability of man's search for a comprehension and mastery of nature. His achievement stands as fitting historical counterpoint to our own contemporary awareness of the inadequacy of viewing science as simply "systematized positive knowledge."

The authority, power, and subtle influence of Pagel's work are well reflected in the essays in this festschrift. The 38 contributors range from the regius professor of modern history at Oxford to the editor of the *Bulletin of the New York Academy of Medicine* (and represent the United States, England, Germany, Italy, Poland, Denmark, and Austria). Their essays discuss topics as varied as medieval optics, Renaissance anatomy, and "Newton and the Hermetic tradition." A sympathetic introduction by the editor, a bibliography of Pagel's writings, and a plethora of illustrations complete this handsome and well-produced work. Among the gems thus offered to us, this reviewer was particularly impressed by A. G. Keller's provocative study of "The idea of technical progress in the sixteenth century," J. R. Ravetz's thoughtful discussion of "Francis Bacon and the reform of philosophy," and I. B. Cohen's careful examination of "Newton and Keplerian inertia." Any full evaluation of the riches present in these two volumes will obviously require the combined attention of many specialist scholars. But the general reader who wants to know why the origins of modern science aren't what they used to be could well begin by browsing through these essays.

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History through Bibliography

Natural Science Books in English, 1600–1900. DAVID M. KNIGHT. Praeger, New York, 1972. x, 262 pp., illus. $22.50. Illustrated Books Series.

Knight addresses this book to the book-lover. Collectors and bibliophiles, who find in books a pleasure needing no particular justification beyond itself, and historians, for whom books constitute the stuff from which to fashion an understanding of the past, and who often tend to develop an esthetic attachment to the printed word and picture—these are the readers Knight claims to have in mind in surveying, through its books, the English-language scientific tradition from 1600 to 1900. The result is a look at British science in the 17th, 18th, and 19th centuries (American science justifiably receives relatively