philosophy is that numerous possible directions remain open for the future.

JAN GOLINSKI

Günter B. Fettweis; Günther Hamann, (Editors). *Über Ignaz von Born und die Societät der Bergbaukunde: Vorträge einer Gedenkveranstaltung zur 200. Wiederkehr des Gründungstages im September 1786 der ältesten internationalen wissenschaftlichen Gesellschaft.* (Österreichische Akademie der Wissenschaften, Philosophisch-Historische Klasse, Sitzungsberichte, 533.) (Veröffentlichungen der Kommission für Geschichte der Mathematik, Naturwissenschaften und Medizin, 49.) 153 pp., illus., apps., bibls. Vienna: Verlag der Österreichischen Akademie der Wissenschaften, 1989. DM 40 (paper).

The life of earth and mining scientist Ignaz Elder von Born and the founding and accomplishments of his Society of Mining Science, the first international scientific organization, inspired the Austrian Academy of Sciences' 1986 commemoration of the 200th anniversary of the society's founding. The editors, Günter Fettweis and Günther Hamann, have organized four significant articles, beginning with Hamann's biography of Born (1742–1791). Born's intellectual and scientific life exemplified the Enlightenment pansophic spirit and utilitarian agenda. The holder of several important geological and mining academic and professional posts, Born was committed to Europe-wide geological field research and practical mining and metallurgical applications. His own mineralogical experiments contributed to the quantitative chemical classification of minerals. His Freemasonry epitomized his cooperative creed—international in scale—an effort obvious in his meticulous scientific publications and recognized in the esteem accorded him. His belief in scientific advancement through international ties resulted in the founding in 1786 of the Society of Mining Science—later the Austrian Academy of Sciences—the seed of international scientific union.

Günter Fettweis turns the discussion to the society and its agenda in physical geology, mineralogy, mining and metallurgical technology and history, and general physical science. Gunnar Almgren and Anders Heltzen discuss the close Scandinavian association with the society, focusing on Swedish contributors in iron and copper metallurgy, mineralogy, and assaying. Last, Alfred Weiss provides a thought-provoking backdrop of contrasts in later eighteenth-century mining, the historiography of which reflected a modified view of natural resources and practical science that was swayed by the exigencies of European politics, economics, and rising mercantilism.

The general unfamiliarity with Born's importance, his time, and his bibliography are ideally remedied in this compact but comprehensive presentation. In addition, the reproduction of the short-lived society's two rare published volumes (1789, 1790), essentially the first international scientific journals, contributes a graphic insight into the early cooperative exchange of scientific ideas and information.

WILLIAM J. MCPEAK

■ Nineteenth Century

Nahum Kipnis. *History of the Principle of Interference of Light.* (Science Networks Historical Studies, 5.) 271 pp., illus., figs., tables, app., bibl., index. Basel/Boston: Birkhäuser Verlag, 1991. $78.

Since the 1960s the early nineteenth-century revolution in optics has been the subject of considerable scholarly discussion. Complementing the recent work of Jed Z. Buchwald, which stresses the contributions of A. J. Fresnel, this newest account of the rise of the wave theory argues for the preeminence of Thomas Young in the whole affair. The argument turns on the proposition that Young's discovery, the principle of interference, was the most important optical innovation of the period and the key to the fortunes of the wave theory.

The interference of light was a hard-won concept to which Young was led only after having grasped the principles of the superposition of waves and acoustical interference. By applying the interference principle to optical phenomena, he produced a far-ranging theory of "periodical colors" that was mathematical in form and confirmed by experiment.

Why the theory failed to evoke a positive response has long been a puzzle. Often it has been noted that Young's mode of presentation was terse, fragmented, and difficult to follow. In addition, of course, there was the substantive problem that to accept

Young's theory was to impugn the corpuscular theory, which held universal sway and was incapable of accommodating interference. Interpreted physically, what could Young's principle mean but the interference of waves? Here Nahum Kipnis introduces a novel consideration. Until about the middle of the second decade of the century, when Fresnel began to press the case for waves, the orientation of physicists was basically qualitative and physical rather than mathematical. In optics this meant that the nature of light, whether corpuscular or wavelike, was the overriding issue, and under the circumstances there was little chance for Young's theory to receive a favorable hearing.

With the passage of time, however, a movement to mathematize physics took hold, and when Fresnel (possessed of more knowledge of Young's work than is usually supposed) reintroduced the principle of interference, the stage was set for a more positive evaluation of its claims. For the principle of interference to benefit from the keener appreciation for mathematics, it needed to be decoupled from the wave theory, since corpuscular optics remained as deeply entrenched as it had been in 1800. This, Kipnis argues, is what happened. When the jury of the Academy of Sciences with a majority of emissionists awarded the annual physics prize to Fresnel in 1819, they were not sanctioning the wave theory; rather, they were acknowledging the success of a mathematical treatment of diffraction based upon the principle of interference. Now emissionists, no less than undulationists, adopted the principle. Only later was the wave theory generally adopted, brought in by the back door when it was realized that interference and the wave nature of light were inextricably linked.

Set out deftly by Kipnis, the argument has a certain plausibility. But by its exclusive emphasis on what admittedly may have been the main prop of the wave theory, it undervalues other components of the optical revolution and diverts attention from the whole. Did the wave theory triumph simply as an incidental wrapper around a useful mathematical principle or as a total theory combining quantitative precision with a unitary explanation for a wide array of diverse phenomena? On the whole, the empirical findings that challenged and in the end validated the wave theory are slighted in this account. While care is lavished on mathematical derivations, references to experiments are brief, generalized, and abstract. The optical revolution awaits its Shapin and Schaffer.

But all in all Kipnis deserves high praise for an admirable book. It displays a thorough mastery of the literature, including unpublished dissertations; it gives good grounds for amplifying or revising conventional accounts of a number of specific matters; and it cogently develops a fresh and provocative thesis without being ponderous. One could only wish that before publication the manuscript had been gone over by a sharp-eyed copy editor whose native tongue was English. Stylistic slips and typographical errors abound.

ROBERT H. SILLIMAN

Brigitte Lohff. *Die Suche nach der Wissenschaftlichkeit der Physiologie in der Zeit der Romantik.* (Medizin in Geschichte und Kultur, 17.) xii + 262 pp., bibl., index. Stuttgart/New York: Gustav Fischer Verlag, 1990. DM 78 (paper).

Brigitte Lohff lets her physiologists speak for themselves. Having combed through an enormous body of little-known literature, she is in a position to present a remarkably rich impression of the philosophical issues at stake for the so-called sciences of experience (*Erfahrungswissenschaften*) at the beginning of the nineteenth century.

By concentrating on what contemporary scientific writers had to say about the metaphor of a "path" to knowledge, the tortuous routes from perception to knowledge, their ambivalent esteem for empiricism over speculation, the limits of experiment, and the process of gathering and gluing together the fragments of individual experiences into a systematic science of experience, Lohff splinters the monolithic image of romantic science that once plagued the historiography of *Naturphilosophie*. In place of earlier visions of romantic science as a unified discourse, we get the sense of a babel of sometimes overlapping concerns.

Lohff follows a swelling trend to use formulations like "physiology in the age of romanticism" in place of "romantic physiology." One may legitimately object that it is not so easy to slip through the clutches of historical concepts. But this move does enable Lohff to address the philosophical reflections of actively engaged investigators of nature without explaining them away in terms of clichés about the evils of specula-