Book Reviews

Reformers in Physiology

Two Great Scientists of the Nineteenth Century. Correspondence of Emil Du Bois-Reymond and Carl Ludwig. Collected by Estelle Du Bois-Reymond; foreword, notes, and indexes by Paul Diepgen. Translated from the German edition (Leipzig, 1927) by Sabine Lichtner-Ayèd. Paul F. Cranefield, Ed. Johns Hopkins University Press, Baltimore, 1982. xx, 184 pp., illus. $15.

Carl Ludwig invented the kymograph, published fundamental studies on cardiovascular and other functions, and trained a generation of physiologists. Emil Du Bois-Reymond opened the way to the study of the role of electricity in nervous and muscular phenomena. Both were members of the "1847 group": with Hermann Helmholtz and Ernst Brücke they set out at mid-century to create an organic physics, a militant new physiology based on quantitative and experimental analysis and scornful of the vagaries of vital force ideas. Both cut imposing figures in the historiography of 19th-century science. Their correspondence reveals what is less well known: a close, warm, and long-sustained friendship that comprised shared views on science and scientists and similar career struggles. Originally published in German with thorough annotations by Paul Diepgen, these letters are now made accessible to English readers in a fine translation. Spanning nearly half a century, from 1847 to 1894, the exchange is densest and liveliest in its early years.

The letters give life and specificity to the physicalist program of the 1847 group. In part this was a posture, a set of attitudes firmly held and often pointedly expressed. In the relentless bright light of the ideal rigor and exactitude both men pursued, no field but physics escaped censure. Ludwig wrote that he decided to study science only "after working my way through all the medical men's old rubbish for six years as a student, realizing at long last that it was unfounded." Du Bois-Reymond snapped that "all chemistry has so far been nothing but shopkeeper's bookkeeping." Anticipating incomprehension of his own work, Du Bois-Reymond asked gloomily, "But can one hope with this to get through to the physiologists, before whose coarsely woven visual matter the most that the word electricity conjures up is the rococo image of a colossal electrostatic machine on feet of sealing wax?" As for the traditional fields of systematics and morphology, Du Bois-Reymond revealed his distaste when he complained to Ludwig that his great mentor Johannes Müller "has kept me occupied at the museum, carrying out what is in his opinion the highest activity of the human intellect, namely, classifying fossil vermin." More telling are many details that bear witness to the day-to-day struggle to forge a new physiology. Among these are Ludwig's efforts to learn differential and integral calculus, both men's never-ending love-hate relationship with instruments and instrument makers, and descriptions of experiments completed, under way, or planned.

The correspondence, and Diepgen's annotations, have much to offer on the personal lives of Ludwig and Du Bois-Reymond, the financial and professional hardships of their early careers, their relations with students and contemporary scientists, and the vicissitudes of German politics, academic and otherwise. Very useful name and subject indexes, bibliographies, and forewords by both Diepgen and Cranefield enhance the attractiveness of this edition. Specialists and those with general interest in the history of science are in debt to the Johns Hopkins University Press for making it possible.

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German Chemists

The Formation of the German Chemical Community (1720–1795). KARL HUFBAUER. University of California Press, Berkeley, 1982. viii, 312 pp., illus. Cloth, $40; paper, $14.95.

In 1784 Lorenz Crell prefaced an issue of his recently founded journal *Chemische Annalen* with some thoughts on "the inherent, I might almost say inborn, propensity of the Germans for chemistry." Although today we would not invoke the cause Crell alludes to, the fact remains that in the 18th and 19th centuries German chemists were preeminent in ways that were widely acknowledged by scientists in other nations. Yet within Germany itself, which in the 18th century remained a collection of independent states, a national community of chemists was not firmly established until the 1790's. Now, thanks to Karl Hufbauer's extraordinarily detailed research, we know who the chemists were who created this community, where they worked, and how they generated the sense of common interest that in the 19th century provided the basis for the professionalization of German chemistry.

The depth of Hufbauer's research can best be appreciated by turning first to the three appendixes that fill the second half of the book. In the first he provides biographical profiles of the 65 leading German chemists of the 18th century, in the second he gives brief histories of the 59 German learned institutions that employed chemists as professors or academicians during the 18th century, and in the third he identifies the subscribers to Crell's journal. The material contained in these appendixes, as well as other carefully quantified information on topics such as patterns of citation, salary levels, and publication rates, has also been subjected to various forms of analysis, the results of which are presented in 21 tables included in the first half of the book. Anyone interested in any of the subjects Hufbauer addresses in his book can now consult what is virtually a social encyclopedia of 18th-century German chemistry.

Hufbauer's interpretation of his data, though frequently insightful, is less impressive. He is to be commended for his clear descriptions of the historical and cultural conditions in which the German chemists worked and his narrative account of the reception Lavoisier's "French chemistry" received in Germany. But when he reaches further in an attempt to explain the appeal of chemistry in the age of enlightenment and the ways social factors influence science in periods of theoretical upheaval, he is notably less successful.

Hufbauer analyzes German support for the development of chemistry in terms of moral, material, and manpower factors. Regarding the first he declares, "My thesis is that moral support for chemistry emerged in 18th century Germany because educated and powerful Germans embraced new values that made them more receptive to new information being disseminated about that science" (p. 14). Hufbauer here uses the term "moral" to describe all non-material cultural support for chemistry. He is correct, of course, in seeing chemistry's

rising status as connected to changing values, but I think it is unfortunate he does not distinguish among the various systems of values that were being transformed. Moral values, in the strict sense, played almost no role in increasing support for chemistry in the 18th century, but changes in political, epistemic, social, and economic values were of great importance. In the absence of distinctions of this sort it is difficult to see why the rather extravagant claims made for chemistry in the 18th century received a sympathetic hearing.

In the introduction Hufbauer declares that his "entire argument presupposes that the formation of the German chemical community was essentially a social process" and that the views held by this community "were more akin to an ideology than a Kuhnian paradigm" (p. 5). True to this presupposition, he takes no account of the theoretical content of the chemical work actually done within the community during the period of its formation. I am in no position to argue that there was indeed a paradigm that provided a distinctive research program for this community, although I strongly suspect one would find one by examining G. E. Stahl's influence. What is clear is that we are given no reason to believe that the ideological as opposed to the paradigmatic approach uncovers the whole truth in this case.

Hufbauer offers what he calls a "conflict interpretation" to explain the final coming to consciousness of the German chemical community. The relevant conflict was a heated debate over Lavoisier's antiphlogistic theory, an episode Hufbauer characterizes as "a struggle for the German chemical community's allegiance" (pp. 118–119). But his interpretation of the events he describes at length (chapters 7 and 8) is undermined by a simplistic view of how theory change takes place in science. Do scientists choose a new theory because they find the evidence and arguments for it compelling, or do external factors, such as national pride, self-interest, and community allegiance, dominate their choices? Such an either-or approach contradicts Hufbauer's own description of the experimental work involved in the struggle. Moreover, having decided not to give any weight to the conceptual arguments in this debate, Hufbauer is forced to make excessive claims for the influence of social factors. Kuhn is again invoked, this time to substantiate the assertion that social factors play a predominant role in theory choices entailing selection between incommensurable paradigms. Yet the facts in this case provide no evidence to support the dubious notion that, historically, paradigms have ever been truly incommensurable.

The shortcomings of this book should not be overemphasized, for they flow from the author's admirable willingness to reach beyond his evidence and engage the big issues in the history of science. The book's enduring value is the direct result of the author's thorough research and careful analysis of his data.

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Mathematics from Poland

The Scottish Book. Mathematics from the Scottish Café. R. DANIEL MAULDIN, Ed. Birkhäuser Boston, Cambridge, Mass., 1982. xiv, 268 pp., illus. $24.95.

The Scottish Book is a Polish book. A group of Polish mathematicians used to meet Saturday evenings in the Kawiarnia Szkocka (Scottish Coffee House) in Lwów beginning in 1935 and continuing for almost six years. A large notebook (subsequently named after the meeting place) was left in the custody of the headwaiter. It contained problems—challenges to one and all by the brilliant younger members of the group as well as by the established seniors. Almost all the names signed to the problems have become internationally famous. Examples: Banach, Mazur, Ulam, Schreier, Steinhaus, Orlicz, and Schauder; an occasional foreign visitor such as Fréchet and von Neumann; and, after the Russian occupation, a small number of Russians such as Alexandroff and Sobolev.

Sometimes the challenger offered a prize for a solution. In 1936 Steinhaus offered 100 grams of caviar for an explicit computational answer to one of his questions, a small beer for a mere existence proof, and a demitasse for a counterexample; in 1940 Saks offered one kilo of bacon. (The Russians came in 1939.)

The total number of problems is 198 (numbered from 1 to 193, with five afterthoughts such as 10.1 and 188.1), and most of them are about Polish mathematics. (That's not an ethnic slur. An expression such as "Polish space" has become a precise and universally accepted technical term.) Something like 60 of them are about real analysis (sequences of real numbers, derivatives of real functions frequently of several real variables), 35 about general topology, and 30 about functional analysis (mainly Banach spaces). The rest are scattered over measures, groups, sets, convexity, combinatorics, and probability; there are one or two about complex function theory.

In May 1979 in Denton, Texas, a few of the erstwhile participants and visitors, and several other problem enthusiasts, met at a conference dedicated to the Scottish Book; the volume under review grew out of that conference. It consists of five lectures, followed by statements of all the problems (frequently annotated by commentaries, solutions, and references). A commentary is sometimes a brief comment or a statement of a pertinent theorem, and sometimes several pages of serious mathematical discussion.

The lectures are by Ulam, Kac, Zygmund, Erdös, and Granas. Ulam tells a lot about Ulam's views (on, for example, joint papers in mathematics, and concreteness versus abstraction). Kac presents some autobiography, describes part of his own work, and gives some curiously offhand references to the literature ("published around 1940 in the Bulletin of the American Mathematical Society"). [Incidentally, I cannot resist commenting on a terminological observation of Kac about "what Tony Martin called a decimal binary (which is an excellent name for what ordinary mortals call simply a binary)." I object. "Decimal" refers to 10 and "binary" to 2, and I find the phrase "decimal binary" philologically illiterate—it grates on me.] Zygmund is from Warsaw and had only a "loose" contact with Lwów; he talks mainly about the work of Steinhaus. Erdös captures the spirit of the Szkocka beautifully; he discusses several problems and, when possible, their solutions; he emphasizes that some of them are still not solved; and, characteristically, he offers $100.00 for the solution of one of them. The Granas work is a long (17 pages) technical paper ("KKM-maps and their applications to nonlinear problems"), complete with definitions, theorems, and proofs. Its connection with the Scottish problems is tenuous, and its presence in this volume is totally inappropriate.

It is hard to choose "typical" excerpts from a work with a focus as wide as this one has; the best I can do is offer the following four problems. Their main virtue (which makes them not completely representative) is that their statements are not too technical; their main fault is that (with one exception) they do not make contact with "serious" mathematics.

10.1. THEOREM. If $\{K_n\}_{n=1}^{\infty}$ is a sequence of convex bodies, each of diameter $\leq a$ and the sum of their volumes is $\leq b$, then there