invited participants from nine countries includes some of the best-known names in neurotransmission research; among them are Julius Axelrod and Bernard Katz, with whom von Euler shared the 1970 Nobel Prize in Physiology or Medicine. Also listed are many of his former students, who seem to have inherited not only the topics that are linked with his name—substance P, prostaglandins, noradrenaline (alias norepinephrine), and transmitter storage vesicles—but also some of his style as a researcher. Characteristic of that style has been the ability to identify a significant finding and then to define the conditions that allow it to be replicated or modified until the underlying mechanism emerges, and with it significant new findings. It is the infantry's way of advancing rather than the cavalry's, but the ground stays won.

The volume's title might mislead some prospective readers, for not much history or biography is offered; what the contributors were asked to do, and have done well, was to sum up their own recent work and to place it in the context of current knowledge. The papers are arranged in nine sections, each accompanied by a short "chairman's overview." The topics include developmental plasticity of synapses, vesicular storage of transmitters, transmitter discharge and its presynaptic and trans-synaptic modulation, receptors and the links between receptor occupancy and cellular response, interactions between "classical" and neuropeptide transmitters, and some implications of the newer findings for pharmacology and medicine.

The book's coverage is thus wide-ranging; it is also, and intentionally, uneven. Not surprisingly, the biochemical aspects of synaptic transmission receive more attention than the biophysical or morphological aspects, and among the 20 or more known or presumed transmitters it is most often one of the classical pair, noradrenaline and acetylcholine, that is brought to the center of the stage. The neuropeptides, it need hardly be said, have won at least the status of featured players. They interact in subtle ways with the other transmitters and may reside in the same neurons, perhaps even in the same vesicles. Among the minor actors, the presynaptic action current, after years of disrepute, has recovered respectability as a transmitter even at mammalian synapses; adenosine triphosphate and adenosine are at least synaptic modulators, and perhaps primary transmitters; and the potassium ions that emerge from excited nerve terminals may also help to effect transmission, as von Euler himself suggests in the book's opening paper. I found it rather odd that hardly anyone mentions the amino acid transmitters, which probably operate at more synapses in our brains than all the other transmitters combined.

The chapters that provide most stimulation will vary from reader to reader. I was pleased to have both Lennart Stjärne and Asa Blakeley *et al.* confirm that a nerve impulse, when it invades an adrenergic fiber, will release transmitter from only a few of the beaded storage sites that are strung along the fiber's length. Why this should be so has not yet been elucidated, and one would like to know if the phenomenon is a common one: do most axons in the brain work in that way too? Year by year, as we learn more about neurotransmission, synaptic mechanisms look less and less like digital switching devices.

The historical dimension appropriate to the occasion is supplied in the paper by von Euler and in the closing paper by Katz. Their retrospective accounts are engaging and their advice on current priorities is provocative; they are a welcome bonus for all the book's readers.

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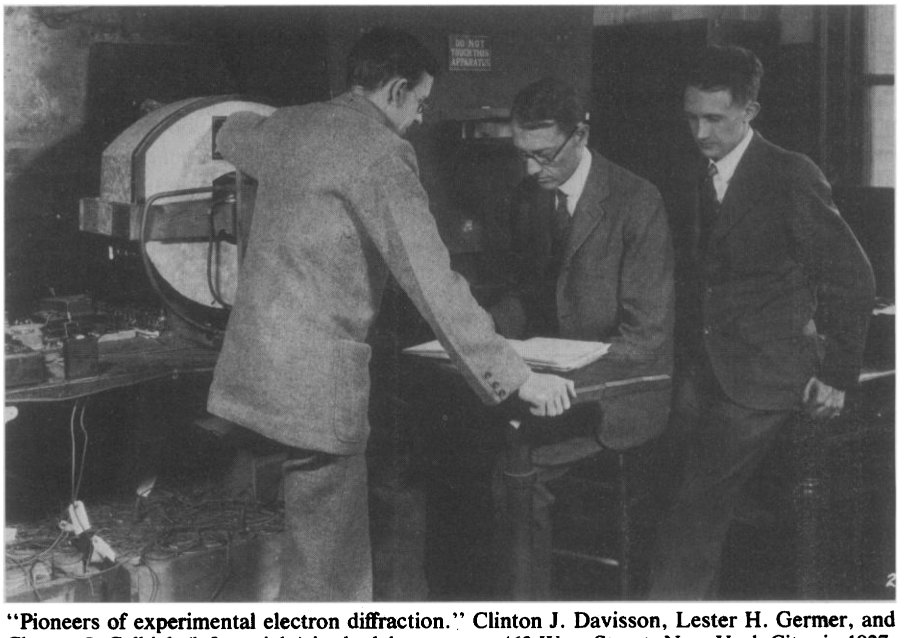
A Harnessing of Electrons

Fifty Years of Electron Diffraction. P. GOODMAN, Ed. Published for the International Union of Crystallography by Reidel, Boston, 1981 (distributor, Kluwer Boston, Hingham, Mass.). xiv, 440 pp., illus. Cloth, $75; paper, $39.50.

When de Broglie "lifted a corner of the great veil" his wave hypothesis implicitly encompassed the idea of electron diffraction, but full appreciation and experimental confirmation of the effect were delayed for several years. A far longer period elapsed before improvements in electron optics and in vacuum technology enabled the unique properties of electrons adequately to be harnessed as a sensitive probe of the local microstructure and composition of matter. Here we have a fascinating account of these events. De Broglie's own brief contribution might indicate some lack of endorsement of subsequent work, particularly the dependence on Schrödinger's theory, but he could scarcely fail to be impressed by the experimental results that can be achieved today.

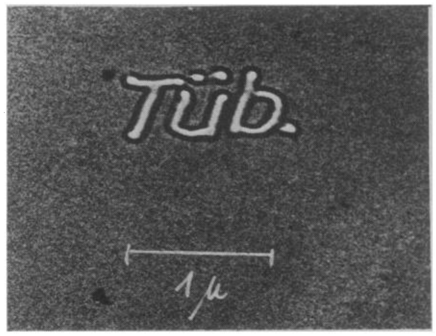
Electrons interact much more strongly



"Pioneers of experimental electron diffraction." Clinton J. Davisson, Lester H. Germer, and Chester J. Calbick (left to right) in the laboratory at 463 West Street, New York City, in 1927. "Note the apparatus in the background; Germer is seated at the observer's desk, ready to read and record the electron current from the galvanometer (the large 'box' beside his head); the banks of dry cells behind Davisson supplied the DC voltage for the experiments." [From *Fifty Years of Electron Diffraction*; photo courtesy of Bell Labs] with matter than do x-rays and hence can be used for more sensitive study of small samples such as gas molecules, thin films, or surfaces. Initially, however, only gas-diffraction studies were tolerably free from contamination problems or difficulties of interpretation due to multiple scattering, that is, dynamical diffraction effects. Any resemblance of the history of electron diffraction to the continuously unfolding success story recounted in *Fifty Years of X-Ray Diffraction*, published almost 20 years ago, is thus confined to the gas scattering work. Nevertheless, the history of electron diffraction is possibly more interesting because of its delayed and dramatic flowering in the last two decades of the period reviewed. In the earlier years, when successes were few and there was no obvious line of inquiry to impose coherence and discipline, a variety of rather independent schools developed in different countries. The sections of the book consisting of lightly edited reminiscences are very well suited to the style of this period. Among the Chaucerian cast one can discern prickly egocentrics, fruitful partnerships, magnificent impresarios, persistent plodders, glorious birds of passage, and even the odd deceiver. Differences of emphasis or even straight contradictions between accounts can be analyzed with interest. Rediscoveries of old ideas or errors abound, as do good ideas tried out too early or sadly missed opportunities. Hibi's account is especially poignant here.

The technical virtuosity of the low-energy experiments of Davisson and Germer, conducted as part of a more general study, emerges clearly and in strong contrast to the more directly targeted high-energy transmission experiments of Thomson and Reid. Fresh light is thrown on this familiar story by the inclusion here of the early work of Kikuchi. Each of these experiments fathered a whole national tradition that persisted for many years. In gas diffraction the work of Mark and Wierl exerted a seminal influence. The observations of Ramsauer and Townsend—surely the earliest demonstration of diffraction effects in electron scattering, though interpreted only with hindsight—receive no mention.

The revolution whereby electron microscopy and diffraction-contrast methods developed and supplanted x-ray diffraction as the dominant microstructural tool in many laboratories can be traced from the instrumental contributions of Finch, Mollenstedt, and Boersch, through the gradual appreciation of the diffraction-contrast basis of images by



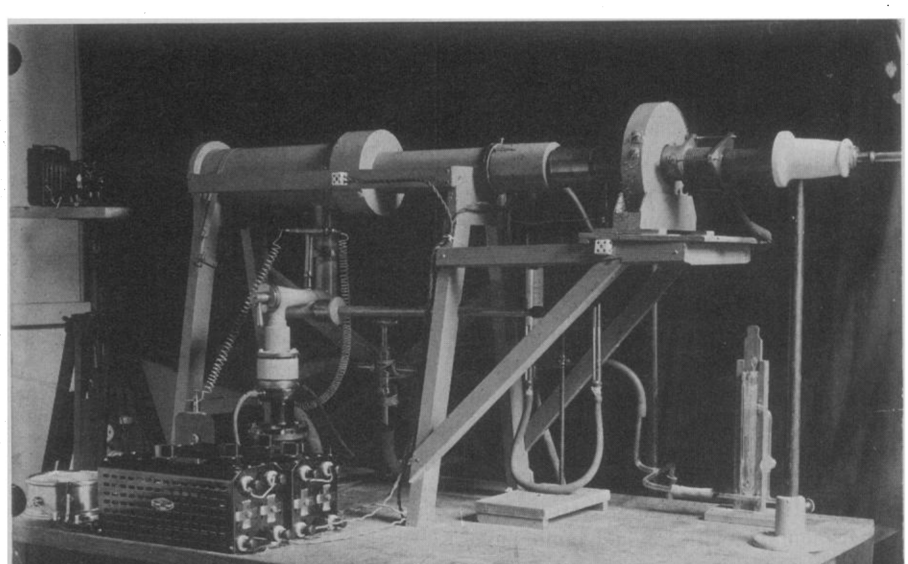
"A monogram demonstration of the micro-writing technique developed at Tübingen University." [From *Fifty Years of Electron Diffraction*]

Heidenreich, Sturkey, and the Japanese school, to the crystal-defect studies of the Cambridge group under Hirsch. An excellent, if rather brief, review of transmission electron microscopy is provided by Amelinckx. More space could well have been given to high-resolution microscopy and its achievements in materials science, chemistry, mineralogy, and biology.

A parallel revolution, facilitated by progress in computation, occurred in diffraction theory. Bethe's esoteric dynamical theory, adapted to the transmission case by MacGillavry, could be understood, as Ewald was amazed to discover, by a whole roomful of conference delegates, albeit each with his own formulation. The uninitiated reader could not hope to do more than acquire a kind of name-dropping acquaintance with such matters as the dispersion surface, the column approximation, or the slice method from this book, but appropriate references are given. He or she may sense how the dynamical theory has been cut free from the confines of reciprocal space to find a more natural home in real space describing accurately the propagation of waves in perfect and imperfect crystals. The absence of any discussion of the complex potential, the interference effects exhibited by inelastically scattered electrons, or the crystallographic anomalies in transmission, backscattering, or x-ray production is unfortunate.

Low-energy electron diffraction and its application to all kinds of surface structures and reconstructions are the other main success story of the past decade and are well reviewed by Van Hove. But for the persevering efforts of Farnsworth, the subject might have collapsed completely before ultrahigh-vacuum technology developed and Germer returned to the field in true cometary fashion. Once again enormous computational progress was associated with the work, and the use of the complex optical potential made a significant contribution.

There are many excellent pictures in the book, but the glancing angle image of surface steps on silicon is remarkable and would surely have caused Germer to alter his advice to Honjo to abandon such work in favor of low-energy diffraction. The note of high promise on which the first 50 years have been completed is illustrated by this achievement and by many other developments that are not discussed in detail. Most notably, the field-emission gun has provoked a new instrumental revolution in the form of scanning transmission electron microscopy, has enabled dislocations to be imaged near the surface of bulk specimens,



"The first French electron microscope," constructed by Trillat and Fritz at Besançon in 1933. [From *Fifty Years of Electron Diffraction*] and has allowed genuine electron holography to be demonstrated as a useful technique. We have good grounds to hope that the story of the next 50 years of electron diffraction will be just as exciting and interesting as the history to date.

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A Portrait

Night Thoughts of a Classical Physicist. Russell McCormmach. Harvard University Press, Cambridge, Mass., 1982. x, 220 pp., illus. $15.

This book uses a fictional format to describe a few days in the daily life of an old physics professor (including his reminiscences and dreams) at an unspecified Prussian university. The time is September 1918; the World War draws to a close, and other endings are also imminent. The professor is a composite figure: his thoughts, impressions, and recalled incidents are based upon historical records. He is reaching the end of a life spent in physics at a time when his guiding principle, the unifying world-ether, is losing its dominance. At the same time the self-confident political, social, and cultural values of German-speaking people are being brought into question, as are the institutions that embody them. The theme of suicide (exemplified by the cases of the physicists Ludwig Boltzmann and Paul Drude) keeps rising to the surface of the old professor's thoughts.

The book is authentic with regard to its time and place and its concern with the intellectual issues of the day. Russell McCormmach is a well-known historian of science; he has constructed his "classical physicist" with sensitivity, erudition, and skill, rounding out the picture with historical notes and a section on sources. His antihero, Viktor Jakob, is fussy, likable, and not very successful. A student of the physicist A. Kundt and of Hermann von Helmholtz, whom someone called the "Reich Chancellor of physics," Jakob holds a second-class position (honorary ordinary professor of theoretical physics) at a provincial university. He has had no control over experimental facilities, which could have given him higher prestige and greater opportunity for professional advancement. He suspects he may have suffered from having a Jewish-sounding name, although he is not Jewish.

Jakob is dominated by his overbearing director and believes he is treated with disrespect by the custodian of the physics institute. The latter abuses an old cat named Maxwell, whom Jakob befriends. (The cat dies, too.) Jakob has nightmares about lecturing to bored students while being observed by Friedrich Althoff, the Prussian Minister of Culture. Perhaps the university milieu was as petty and mean-spirited as is suggested, but the picture may be overdrawn.

The main thrust of the book is in the changes it rings on the meaning and status of classical physics, a decade or two into the relativistic and quantum physics revolutions (the latter being the more serious challenge). Jakob ponders these attacks on the classical world-order and then begins to list integrative themes (inertia, mass, charge, and so on). He contrasts classical and romantic styles in doing physics, as one sometimes does in art and literature. He harks back to the supposed affinity between the values of 19th-century Teutonic culture and those of the classical period of Greece.

The idea of this book as a possible new genre in science history is so appealing

The Balcony Room by Adolf von Menzel. "In Jakob's judgment, some artists' paintings had no more beauty than [the] spotted handkerchief [with which he had just wiped up a spill]. By beauty, then, he wasn't referring to the naive daubs of the Expressionists. (Their ideas were equally naive. They talked bombastically of unveiling the reality beneath the reality. Physicists had long known such talk was meaningless. . . .) Still less was he referring to paintings in the so-called Youth Style, with their undisciplined images. . . . No, he had in mind paintings with the shimmering clarity of Menzel's *Balcony Room*, which hung in reproduction in his study. . . . Menzel's little bourgeois interior gave Jakob the pleasure that his own study with its high curtained windows and always freshly waxed surfaces never failed to give him. (Through Helmholtz he had met Menzel in Berlin and later again in Italy, where Menzel was sketching a ship. Each nail must be in its place, each scratch, Menzel had explained. It impressed Jakob, who knew physicists with less conscience.)" [From *Night Thoughts of a Classical Physicist*]