Astronomy and much else besides

Herschel at the Cape: Diaries and Correspondence Of Sir John Herschel, 1834–1838

D. S. Evans, T. J. Deeming, B. H. Evans, S. Goldfarb, *eds.*
398 pp. Univ. of Texas Press, Austin, Texas, 1969. $10.00

Reviewed by ARTHUR BEER

"Lunar animals" reportedly discovered by Sir John Herschel, part of the "moon hoax" started by the *New York Sun* in 1835. The lithograph was copyrighted by Benjamin Day, owner of the *Sun*. (By permission of the Library of Congress.)

"Friday, April 6, 1838—Devised a perfect Swinging Cot and proceeded to fit ours up on the principle . . . cannot but remain horizontal however the ship may incline . . . to deaden the jerks of pitching . . .." So on page 351 this entry appears that refers to a journey from the Cape to England. Page 269 contains the exact recording of a "goatsucker's song;" page 301 a positional sketch of the satellites of Saturn—which is in a letter from the Cape to the writer's aunt Caroline, then 87, who was the sister of Sir Frederick William Herschel, the greatest British pioneer in astronomy; plus nature observation, astronomy, artistic drawing, engineering and administrative politics. All this and poetic imagination merged in John Frederick William Herschel to a unique degree.

"This book begins in the bar of the Grand Hotel, Saltsjöbaden, in Sweden. Lowering our voices to match the subdued and expensive decor, Terry Deeming and I discussed the fact that the Manuscript Library of The University of Texas had acquired a considerable collection of the papers of Sir John Herschel," writes David Evans, who for some 17 years lived in the Royal Observatory, Cape of Good Hope, which was bound up with Herschel's work in South Africa. Four years ago he joined Terry Deeming, professor of astronomy at Austin, and the four authors started the complex task of decoding the Herschel papers and adding several hundred annotations. The outcome is much more than an ordinary "scientist's logbook." Indeed the book presents, as the editors and publishers rightly claim, personal and social history, literary commentaries and detailed results of enthusiastic observations of nature and of experiments—in botany, zoology, geology, ornithology, astronomy, meteorology, chemistry and mathematics. And at the same time it also reflects the excitement of travel, political intrigues and gossip, which are aspects of education and philosophy. All this interpreted by an alert and universal mind.

We also find reproductions of a number of Herschel's splendid landscape drawings obtained with his "camera lucida," a forerunner of his later photographic activity; here he was even the inventor of the terms "negative" and "positive." Later he became Master of the Mint, and was also a member of innumerable committees and commissions. Simultaneously he occupied himself with translations from Schiller, Homer and Dante, while working on the optical and crystallographic properties of quartz, microscope objectives and, with Babbage, on magnetic properties of rotating plates. In astronomy, Herschel's very extensive observations of the southern sky were complementary to his northern work on the structure of the stellar universe, which he had started at Slough in England. There and at the Cape he used and amplified his father's original method of "sweeping the sky" by keeping the telescope fixed at a certain angle and leaving it to the rotation of the Earth to bring, in succession, all available celestial objects. In recording these he was ably supported by his young wife—in the true Herschel tradition of his ancestors, the brother-and-sister partnership of William and Caroline.

A vivid reflection of Herschel's contemporary fame and influence is shown in the famous "Moon Hoax," which, according to footnote 39 (1836) and plate 17, goes back to R. A. Locke in the *New York Sun* in September 1835. A letter from the Cape written by Lady Margaret, John's wife, to her aunt Caroline contains a topical story: ". . . Have you seen a very clever piece of imagination in an American Newspaper giving an account of Herschel's voyage to the Cape with his instruments, and of his wonderful lunar discoveries. Birds, beasts and fishes of strange shape, landscapes of every colouring, extraordinary scenes of lunar vegetation, and groupes of the reasonable inhabitants of the Moon with wings at their backs, all pass in review before his and his companions' astonished gaze. The whole description is so well clenched with minute details of workmanship and names of individuals boldly referred to, that the New Yorkists were not to be blamed for actually believing it as they did for forty-eight hours. It is only a great pity that it is not true, but if grandsons stride on as grandfathers have done, as wonderful things may yet be accomplished." Good reading after 21 July, 1969.

There is also a helpful general survey of Herschel's ways in life and science, —written in a most lively style and presenting us with some invaluable inside stories of a vital period of astronomical history. In one place the authors even try to examine Sir John's wallet, calculating the energy balance of incoming and outgoing financial radiation (in the latter assisted by Lady Herschel's private account book, which was also found in the Texas papers). Some discrepancy appears as to where the sums for a life "like a landed gentleman" actually came from, so that the authors summarize their auditing with the insight that "it all remains a little mysterious, as other people's finances so often are."

Ultrasonics: Theory And Application

By G. L. Gooberman
210 pp. Hart, New York, 1969. $12.00

Ultrasonic techniques are being used in so many fields of science and engineering that a book much more voluminous that the present work would be needed to describe all of the most important applications. If theory is to be included, it becomes obvious that 210 pages simply do not suffice. G. L. Gooberman decided not to do the impossible but instead attempted to present "a selection made at the personal whim of the author."

Transducer theory and design, as well as absorption and dispersion of ultrasound, are the topics that receive more than honorable mention. No radical departures from the usual presentation are evident; that is, equivalent circuits are used to discuss transducers, and relaxation processes are cited to explain some absorption and dispersion phenomena. The book also contains straightforward, basic discussion of wave motion and radiation. Some space is devoted to measurement techniques and various applications. Simplifications can be found throughout the book, for example, ". . . we shall use the term piezoelectricity to describe the properties of both truly piezoelectric and ferroelectric materials."

Recent developments are briefly mentioned. Sonar is dealt with in 21 lines, delay lines are described on one page and epitaxial transducers are discussed in seven lines. Unfortunately, this brevity is coupled with an effort to limit references. There are few; of these about three or four list publications that are more than ten years old.

In general, the book presents in an elementary manner a selection of basic topics and is aimed at the reader who wants to acquire a nodding acquaintance with ultrasonics.

WALTER G. MAYER
Associate Professor of Physics
Georgetown University

Modern Quantum Mechanics With Applications to Elementary Particle Physics: An Introduction To Contemporary Physical Thinking

By J. A. Eisele
541 pp. Interscience, New York, 1969. $19.95

This is an unusual book. In the preface, John A. Eisele explains that the text is based on a course in quantum electrodynamics and elementary-particle physics, intended for "hard-working graduate students," and should be of interest to "PhD's and professors." Eisele has striven to accomplish this "by filling in the steps in which 'it can be shown' or 'it is well known that' usually appears."

In some instances Eisele fills in the mathematical steps with more detail than would be necessary for a bright student of high-school algebra. For example, at least 50 pages are essentially devoted to examples of multiplication of two-by-two or four-by-four matrices. There are several representations for the Dirac γ matrices, and Eisele goes through many of the same derivations two or three times, each time using a different representation and each time filling in all the steps. He does not always live up to his promise to include all the details, for he gives many results with either sketchy proofs or none at all. This is, in fact, a redeeming feature of the work, because otherwise the book would have had to be ten thousand pages long, in order to cover the material.

Eisele includes such varied subjects as special relativity, Maxwell's equations, the old Bohr theory, the nonrelativistic Schrödinger equation, the Dirac equation, Feynman diagrams and beta decay. These diverse topics are treated unconventionally. For example, in discussing the Bohr atom, he invokes the virial theorem to conclude that the total energy is half the potential energy, when this result is easily obtained directly.

Early in the book (page 67) Eisele introduces the Schrödinger equation with the single phrase, "The Schrödinger equation in one-dimension is . . ." The wave function ψ is not defined, and no discussion is given of the meaning of the equation. I have no argument with this; after all, the reader is supposed to be familiar with nonrelativistic quantum mechanics. But after seeing ψ appear hundreds of times in the Schrödinger, Dirac, and Klein–Gordon equations, I read the explanation (page 390): "In quantum mechanics every system is represented by a mathematical function called a wave function or eigenfunction."

The author's treatment of elementary particles is not the usual one. He lists four basic properties that an elementary particle can "reasonably" be expected to have: (1) a "sharply defined, or quantized" mass, (2) a lifetime sufficiently long to "exist and/or be observed," (3) a charge equal in magnitude to that of the electron or zero, and (4) a spin of 0, 1/2, 1, or 2 in units of $\hbar$, others having "not yet been observed."

Eisele neglects to point out that properties (1) and (2) are related by the uncertainty principle: if a particle has a completely sharp mass, it must be stable. In excluding particles of short lifetime, Eisele rejects the usually accepted principle that puts all members of a given isotopic-spin or SU(3) multiplet on the same footing. His list of elementary particles includes only those that are stable or decay by weak interactions. For example, he includes the charged pion, but not the neutral one. But if relative stability is to be the criterion, the Ω^- should be included, since it decays weakly. (Incidentally, the Ω^- is believed to have spin 3/2.)

In addition to electrons and photons, Eisele treats two subjects in elementary-particle physics at some length: beta decay and isotopic spin. The sections on beta decay are concerned with the classical topics, such as selection rules in allowed and forbidden decays, and with nonconservation of parity. Essentially nothing is said about the weak decays of strange particles.

The section on isotopic spin is largely devoted to whether the nucleon has isotopic spin 1/2, 1, or 3/2. Eisele considers the evidence from pion–nucleon scattering, and, using oversimplified arguments, concludes that the nucleon must have isotopic spin 1/2. But sure-