was far from accurate, but it did provide a valuable basis for demographic studies.

His own interests have, as he points out in the preface, led Cassedy to place a considerable emphasis upon the use of statistics in relation to public health and medicine, yet he does place his subject within its economic and political context. Within the limitations he set for himself, the author has done a fine job. The style is clear, and the book is surprisingly lively.

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Giving a Man His Due

The Shadow of the Telescope. A Biography of John Herschel. GÜNTHER BUTTMANN. Translated from the German edition (Stuttgart, 1965) by B. E. J. Pagel. David S. Evans, Ed. Scribner, New York, 1970. xvi + 224 pp., illus. $7.95.

This well-written and scholarly survey of John Herschel's life and work is of particular interest because of the great disparity between John's towering reputation in the mid-19th century and the widespread ignorance of his name after 1900. In my experience, three out of four people who have heard of "Herschel" at all will assume that you have confused the name of his father, William Herschel, and the fourth is himself not clear about the difference. To be sure, John occupies an honorable if minor place in the usual history of astronomy: not like Struve, say, or Bessel or Argelander, but honorable. Historians of photography give John a very satisfying place as the scientific friend of Fox Talbot. He figures prominently in accounts of two movements, the introduction of Lagrangian analysis into Cambridge (the well-known trio Babbage, Peacock, and Herschel), and the attempt of scientists to seize control of the Royal Society in 1830 (Herschel was the scientists' candidate for president).

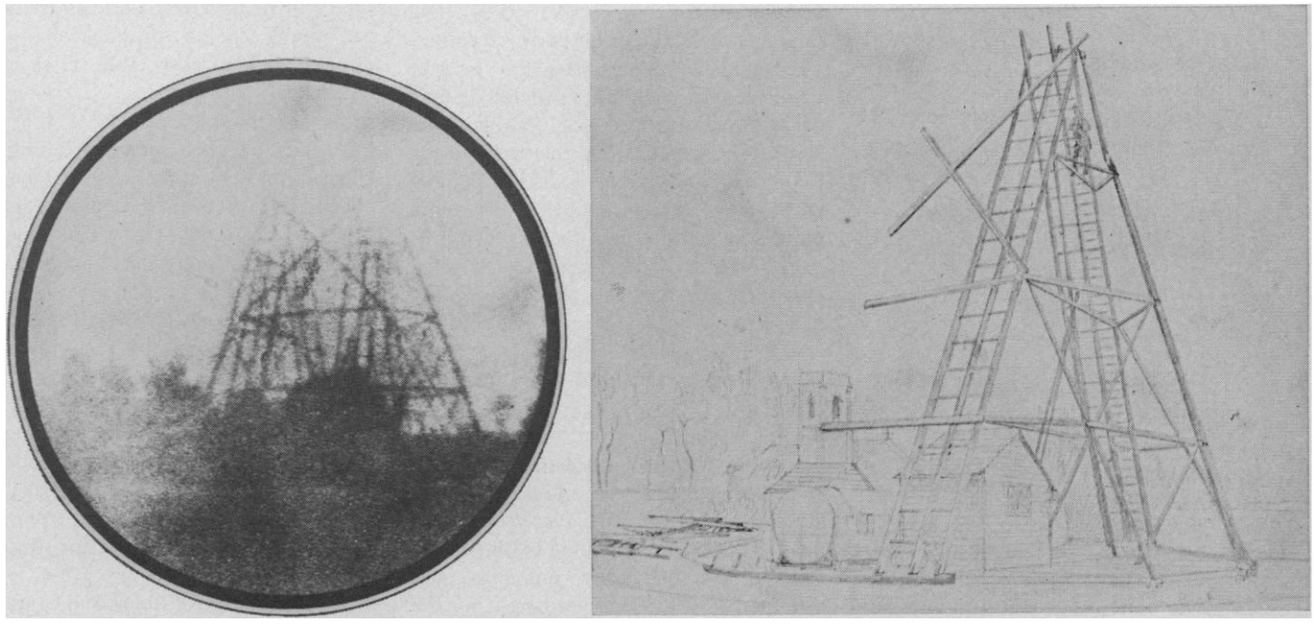
But these accounts are usually disconnected, and they do not help us understand why the name John Herschel may pop up rather mysteriously in a book on infrared spectroscopy, or one on solar physics, or on the British Mint, or on Louis Pasteur. My own insistence that John was actually the founder, in general and in detail, of the modern international network of meteorological observatories was at first met with blank disbelief, for in most histories of meteorology he ranks not at all.

Buttmann's book is therefore most welcome in beginning to bring all of the parts together, so that we can consider an interesting problem: Where did John Herschel go wrong? What does a scientist have to do for his memory to live after him?

One possible answer jumps into view. It is possible to be too good in too many fields. One may then get careless about getting each discovery into the proper channels for prize-winning in each category. One can only sympathize with Bunsen when, after he invented a new ice calorimeter, Thomas Grahame pointed out that John had done the same thing over a decade before. Bunsen complained: How could a chemist be expected to know of the contents of a book entitled *Results of Astronomical Observations Made at the Cape of Good Hope*, even if it was the prize-winning outcome of the most highly publicized individual scientific venture of the last 40 years?

Another answer might be that scientists are too much interested (where credit is at stake) in definite, labelable things, either ideas or instruments, and not so much interested in new uses or new approaches. John's astronomical surveys seem, and in part were, a completion of his father's work. But his real importance is that he, like Struve, was interested in applying precision micrometer standards to stellar astronomy, not merely in collecting and classifying double stars and nebulae. That the same kind of telescope is directed toward the same kind of objects but for a new purpose is harder to see and make exciting than the news of a new kind of telescope or a new order of resolution of nebular structure.

A somewhat less noble answer might



Views of the 40-foot telescope in John Herschel's garden at Slough, England. (Left) A photograph taken by Herschel on 9 September 1839, the first photograph ever taken on a glass plate. (Right) A camera lucida drawing by Herschel of the dismantling of the telescope, 1840. [From *The Shadow of the Telescope* (left, courtesy Science Museum, London)]

be that it pays to claim as much credit as you can while you can, or, better still, have a bunch of followers who will eagerly do it for you because their prestige is bound up with yours. John worked alone, avoided cliques, found disputes distasteful, and never became identified with an institution or organization. Darwin had his Huxley, Kelvin had his Tait, Clerk Maxwell had both Scots nationalism and the Cavendish Laboratory. Even William Herschel had John. But no one consistently took up the cudgels for John's right to his discoveries. It seems not to have occurred even to an intelligent admirer such as the historian Agnes Clerke that his reputation *could* ever die.

Buttmann's book does not provide an answer for all such questions as these—the amount of John Herschel material still unused is so large that he calls his book a "sketch"—but it provides enough for us to begin to ask questions. He does this in a true biographical form, interweaving John's life with his scientific work in human fashion. The American publishers have provided a most handsome format, with good reproductions of 17 illustrations, notes, bibliography, and a scanty index. Even those who have read the German original will find this edition well worth the moderate increase in price, simply from the pleasure of reading good type on good paper. My main objection is to the picture of a sick, tired old man on the dust jacket and also as frontispiece. Granted, this photograph was one of Julia Cameron's masterpieces; but it was not the old man who made his mark on 19th-century science. It was the vigorous middle-aged man who fascinated his young admirers, men like Faraday, Hamilton, Draper, and Airy.

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Big Instruments

Radiotelescopes. W. N. CHRISTIANSEN and J. A. HÖGBOM. Cambridge University Press, New York, 1969. xii + 232 pp. + plates. $14.50.

This is a small book on a large subject, but it is without question the best in its field. The authors are pioneers in radio telescope design and write with the greatest authority on their subject.

The competition is not very extensive. The first comprehensive work on the subject was Pawsey and Bracewell's *Radio Astronomy* (1955), followed by Steinberg and Lequeux's *Radioastronomie* (1960; translated and revised by Bracewell in 1963) and by Kraus's *Radio Astronomy* (1966). Each of these books updated the earlier ones and each was aimed primarily at the undergraduate engineering or astronomy student. Each was a rather general treatment of its subject with one or two chapters devoted to instrumentation. Bracewell's chapter in the 1962 *Handbuch der Physik* was the first attempt to synthesize the entire subject of radio astronomy instrumentation, a subject evolving rapidly and one which has assumed substantial scientific and economic importance.

Unfortunately radio telescope design is neither engineering research nor astronomical research. Radio telescopes embody well-established scientific and engineering principles; they are unique mainly in their size and cost and in the ingenuity with which the basic principles are applied. Papers on radio telescope design are often unacceptable in both astronomical and engineering journals. This creates a problem, for radio astronomical observations must invariably be interpreted in terms of the characteristics of the telescope. An exception to this rule may be in the area of synthetic-aperture telescopes, in which radio astronomers have made unique contributions. Christiansen and Högbom's effort is welcome indeed as a substantial contribution to a field largely neglected in the book literature.

Despite its small size, the present book is encyclopedic in detail. Some of the technical material is heuristic, some is assumed from the engineering literature, and some is skillfully derived from first principles, depending upon the authors' inclinations and priorities. All in all, the treatment is satisfying to the critical and analytically minded reader. Its level of sophistication is that of the advanced graduate student or experienced antenna engineer.

One subject whose treatment disappointed the reviewer to some degree was the response of the correlation interferometer to the electromagnetic field. This is fundamental to the entire subject of correlation antennas and aperture synthesis. Nowhere in the book or in the references is the subject of coherence mentioned, though rigorous treatment of correlation antennas depends completely on the specification of the spatial and temporal statistical nature of the incident waves. Instead, quasimonochromatic fields are assumed in the derivation of the reception patterns of correlation antennas, and the assumption is then made that broadband, spatially uncorrelated sources can be mapped by using the results of these derivations. This gives correct results for the conditions encountered so far in radio astronomy, but the reader should be aware that these assumptions are not reliable in certain limiting cases and should consult the current periodical literature for the coherence theory of correlation antennas.

In summary, this is an excellent book which should be in the library of every radio astronomer and antenna engineer, and which will be frequently referred to even by experts.

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New Astronomies

High-Energy Astrophysics. TREVOR C. WEEKES. Chapman and Hall, London, 1969 (U.S. distributor, Barnes and Noble, New York). xii + 212 pp. + plates. $9.50.

Although the development is viewed with mixed emotions by traditional astronomers, the past decade has seen the birth of a variety of scientist which one might call the "observational astrophysicist." The respectable status of the theoretical astrophysicist has been assured by the importance of the contributions of such men as Eddington, Chandrasekhar, and Hoyle to the understanding of even the most rudimentary observational data. The new observational astrophysicists specialize in new astronomies—cosmic ray, gamma ray, x-ray, infrared, and neutrino astronomy. This little book by Trevor Weekes tells about some of the things they do. The title *High-Energy Astrophysics* was chosen because of the large energies involved in such astrophysical phenomena as imploding stars and radio galaxies and the generally great quantum energy of the light used in the new astronomies.

After getting off to a bad start the monograph steadily improves. Chapter 1 is too brief to be useful as a summary of "astronomical vocabulary," and