

often does not leave the reader with an understanding as would be acquired from a textbook. An extensive mathematical background is required by the reader if he is to follow the development of theory readily and appreciate the specifics of its applicability. However, the book is well referenced and presumably it was Burke's intent to construct the skeleton and let the reader add flesh to the system as needed by use of the bibliography. The intended readers (the preface is so brief they are not indicated) presumably are persons beginning theoretical studies in this field and experimentalists, each seeking a broad-brush resume of the field.

The major coverage of the book in brief is:

- ▶ presentation of working equations and definitions of scattering theory in terms of partial-wave solutions of the Schrödinger wave equation, phase shifts and scattering-amplitude functions
- ▶ applications of this to the Coulomb potential (point charge), to the spin-orbit potential, and to the potential of a one-electron atom
- ▶ the scattering phase shift, restated in terms of the "scattering length" and "effective range", applicable in low-energy scattering situations
- ▶ the relationships existing between the phase shifts and number of bound states of a system
- ▶ the Born approximation, the eikonal method, and a hybrid of the two for evaluation of cross sections in the middle and high energy ranges, and
- ▶ other topics including resonances and variational methods.

One pleasing feature of the monograph is the consecutive numbering of equations throughout with no chapter prefixes. Back reference to an earlier result is quite simple and quick. However, the monograph alone is not adequate as a course text, and its selection as a course supplement will be restrained by the high price established by the publisher.

ROBERT ST JOHN
Department of Physics
University of Oklahoma
Norman

Man Discovers the Galaxies

R. Berendzen, R. Hart, D. Seeley
228 pp. Science History (Neale Watson),
New York, 1976. \$15.95 clothbound, \$6.95
paperbound

The authors of this book have presented Man's discovery of the galaxies in a scholarly and fascinating manner. This adventure belongs almost entirely to the present century, and was followed with excitement by those of us old enough to have watched its development from the beginning. The narrative is well organized factually and is spiced by personal

episodes in the work of the astronomers involved. Richard Berendzen, Richard Hart and Daniel Seeley gathered much of their material from scattered archival sources and provide excellent documentation. From these sources they also collected a large number of pictures, many reproduced here for the first time.

The text is in four parts, each with its own prologue and epilogue. This division provides great flexibility in the use of the book. Non-scientific readers will be well rewarded by supplementing the prologues and epilogues with the well captioned pictures, while more intent readers will be

enticed to include the entire text, in which even professional astronomers will find new material. The book's purpose as a supplementary text for college students is fulfilled in the sections of proposed problems. A series of lively biographies of the principal actors, each with a photograph, are distributed through the book, but set off for separate reading so that the text is not interrupted.

Section I, "The Scale of the Universe," begins with the early island-universe concepts of Thomas Wright and Immanuel Kant, then takes up the observations and conjectures of William Herschel. It

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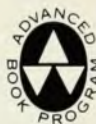
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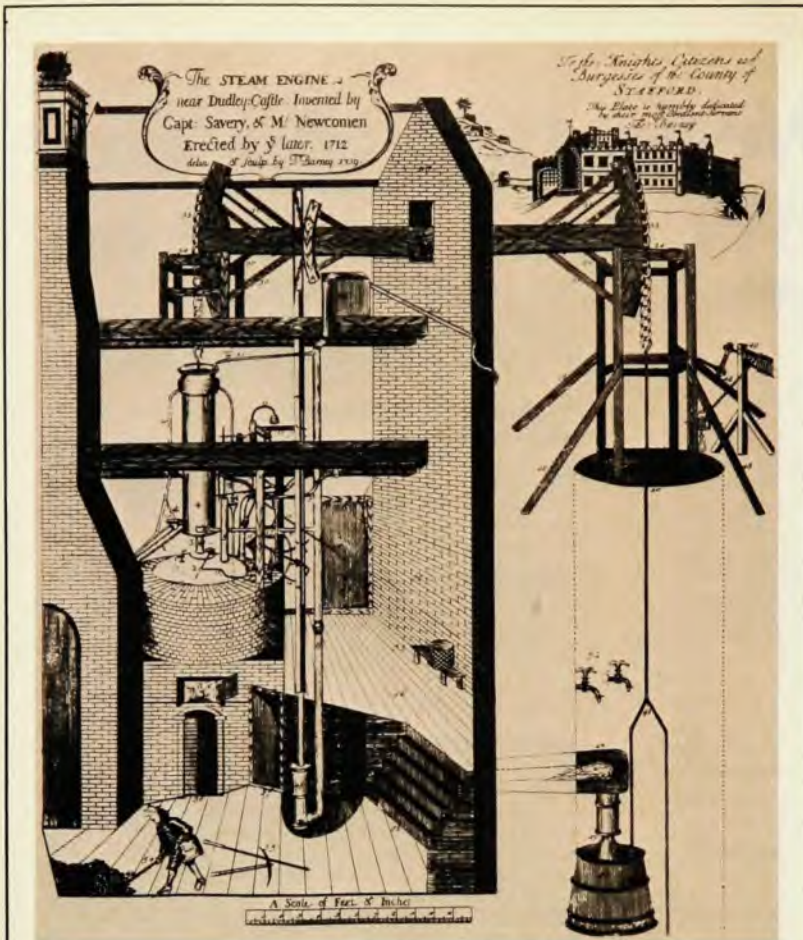
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Thomas Newcomen's first practical steam engine (shown above) was built at the Coneygree Coal Works, Tipton, Staffordshire, UK. It made twelve strokes a minute and delivered ten Imperial gallons a stroke. The diagram is reprinted from L.T.C. Rolt and J. S. Allen, *The Steam Engine of Thomas Newcomen*, Science History (Neale Watson), New York, 1977 (160 pp.; \$15.00), page 47. This book examines the contribution to the Industrial Revolution made by Newcomen's engines, which were built to power factories for those manufacturers who could not pay the very high charges for James Watt's more sophisticated engines.

traces to the present the methods of determining distances within the galaxy and concludes with the "Great Debate" in 1920 between Harlow Shapley and Heber Curtis on the scale of the universe. In this debate the nature of the spiral nebulae was crucial to the arguments. The authors discuss this epochal debate critically and correct some widespread misconceptions of the actual debate as compared with the published version.

In the second part, "Galactic Astronomy," the exploration of our galaxy is described. In particular the Kapteyn and Shapley models, based on star counts and on globular clusters respectively, are presented. The galactic rotation studies of Bertil Lindblad and Jan Oort follow and finally the discovery of general galactic absorption by Robert Trumpler. A consistent picture of the galaxy as a spiral nebula emerges.

"Extragalactic Nebulae," a term now

superseded by "galaxies," is the title of the third section. This portion of the book emphasizes the work of Edwin Hubble in firmly establishing the spirals as galaxies similar to our own, in measuring their distances, and in his discovery of the redshift law. The pioneer contributions of Vesto Slipher, Curtis and K. Lundmark are given proper recognition. A most interesting part of the story has to do with the illusory rotational measures by Adriaan van Maanen for which no satisfactory explanation has ever been offered. The remarkable consistency of these measures was convincing to many astronomers and this evidence retarded the acceptance of spirals as galaxies. The authors review the question in great detail.

The fourth section, titled "The Birth of Modern Cosmology," begins with Newton's studies and Olbers's paradox and traces concepts of the universe through

Einstein's ideas and the several relativistic models growing out of his theory. The static and expanding models are described, including the steady-state and the big-bang theories. The discovery of the 3 K background radiation and its support of the Big-Bang theory are briefly mentioned. Finally the question of the "open" versus the "closed" universe is discussed.

The reader is apt to be left with the impression that about 1920 Curtis and Lundmark were almost alone in supporting the island-universe theory. In 1917 R. F. Sanford published a very persuasive article in its support and in the same year W. W. Campbell made a very strong case for it in his presidential address to the AAAS. One important omission in the book is the fundamental work of Walter Baade in correcting the intergalactic distance scale. This correction made the sizes of the spiral nebulae much more nearly comparable to that of our own galaxy, and also gave an age of the universe from the start of the expansion in much closer agreement with the accepted ages of the stars.

On the whole the treatment by the authors is accurate and well balanced and the material is presented in an attractive style. The book can be read with profit and pleasure by anyone with a serious interest in our place in the universe.

C. D. SHANE
Santa Cruz
California

book notes

The Historical Supernovae. D. H. Clark, F. R. Stephenson. 233 pp. Pergamon, Elmsford, N.Y., 1977. \$15.00 clothbound, \$7.50 paperbound

Supernova explosions have been linked in recent years with important astrophysical phenomena such as pulsars, black holes and x-ray binaries, and thus the authors are justified in claiming that historical records of such explosions are "among the most valuable legacies which the ancient world has bequeathed to modern science." Four long-duration "new stars" of extreme brilliance have been recognized as supernovae within our galaxy; these were seen in AD 1006, AD 1054, AD 1572 and AD 1604. Clark and Stephenson discuss the recorded observations of each in detail, as well as those of four other "new stars" seen in AD 185, AD 386, AD 393 and AD 1181 that may have been supernova explosions. Several historically observed "new stars" have been identified with supernova remnants (such as the star of AD 1054 with the Crab Nebula), and the evolution of these remnants is discussed in the final chapter of the book.

—CBW