S.W. Hawking, W. Israel (eds): *300 Years of Gravitation*. Cambridge: Cambridge University Press, 1987. xiii, 684 pp., figs, tables and bibliographies.

The 300th anniversary of Newton's *Philosophiae naturalis principia mathematica* is celebrated here with a combination of reflective essays on Newton and his historical impact on the one hand and reviews on recent trends in today's understanding of gravity, cosmology and related subjects, on the other. All authors are leading physicists or astronomers, and one of the editors, Stephen Hawking, might really be looked at as our century's successor of Newton, teaching as Lucasian Professor of Mathematics at the University of Cambridge. Together with his co-editor he already prepared a comparable volume in 1979, [1] and many of the articles in this book can also serve as supplement and update of the earlier status-reports, although all of them are self-contained.

Since this is a review for a history-of-science-journal I have to confine to the historical aspects in this rich volume. It is interesting to note, that for the history of recent science the review articles written by the pioneer scientists for journals such as *Reviews of Modern Physics* are the most valuable source to rely on. The large number of active scientists and the enormous number of papers produced by them enforce continual re-search and overview and the resulting reviews then not only serve as guide-line for future research of the practising scientists but also as raw material for the historian of science. Most of the essays in this volume also serve this double purpose of systematic *and* historical orientation.

Experiments on gravitation are treated in A.H. Cook's and Clifford M. Will's reviews, covering the whole temporal range from Cavendish's indirect measurement of the Newtonian constant of gravitation in his 'experiments to determine the density of the earth' (1798) to the most recent discussions about Fischbach's (1986) reanalysis of the Eötvös experiments and a possible fifth short-range force. According to Will, the period between 1960 and 1980 "became the period for testing general relativity" whereas now the "finer predictions of relativity" and higher-order effects classified in his 'parametrized post-Newtonian formalism' are under research.

[1] *General Relativity: An Einstein Centenary Survey*. Cambridge: Cambridge University Press, 1979.

In a fascinating essay, Werner Israel traces the evolution of the scientific idea 'dark stars' from the earliest speculations by Michell (1783) and Laplace (1795 edition of his *Système du monde*) to today's analysis of black-holes in terms of quantum mechanics and thermodynamics inspired by Hawking's challenging theorems. He demonstrates the sequence of disregard, dismay and final beginnings of acceptance after the first unexpected spectroscopic results indicating materials 3000 times denser than normal matter in the Sirus companion (1913f), leading to Eddington's speculations about the *Internal Constitution of the Stars* (1926) and Chandrasekhar's (1931) derivation of the critical mass for compression of matter to white dwarfs, to Oppenheimer's, Landau's and other's papers about Neutron stars, gravitational collapse and horizon effects and the establishment of the discipline of relativistic astrophysics inspired by the need for an explanation for experimental discoveries as quasars (1951-1972) and soon enriched by theoretical speculations about further collapse into a space-time singularity termed 'black hole' by Wheeler (1968). Contemporary understanding and observational evidence for black holes is further summarised by R.D. Blandford and illustrated with the help of useful electromagnetic analogs.

The stages in the evolution of the paradigm of inflationary cosmology, originating in attempts to overcome several pertinent problems of standard cosmology by introducing a brief period of exponential expansion for the early universe being in a metastable false vacuum state are given in review paper by S.K. Blau and A.H. Guth. In the original inflationary universe model by Guth (1981) the universe undergoes a sudden phase transition to the stable vacuum by spontaneous nucleation of bubbles in the new phase. It was soon realised that the randomness of this bubble nucleation process in an exponentially expanding space would lead to gross inhomogeneities contrary to the observed homogeneity of the visible part of the large-scale universe and the isotropy of the 3 K microwave background. Therefore, Linde (1982), Albrecht (1982), and others proposed new inflationary models with a 'slow rollover' phase transition during still continuing inflation. Density perturbations, later leading to the formation of galaxies , are induced by microscopic density fluctuations during the inflationary phase. Linde's chaotic inflationary scenario (1983) is discussed in a separate paper by its inventor. He stresses the fact, that inflation for the first time gives the prospect of a possible explanation of the local *and* global structure of the universe in terms of (classical) inflation plus (quantum) effects in the inflation-driving scalar field without the *ad hoc* assumptions about inital conditions, fine-tuning of input parameters etc. in the standard cosmology.

Chapters by T. Damour about the problem of motion, Kip Thorne on gravitational radiation, M.J. Rees on galaxy formation, A. Vilenkin and Schwarz on aspects of string theory, Crnkovic and Witten on canonical formalism in geometrical theories and Stephen Hawking on quantum cosmology are too technical for detailed treatment here. But one of the gems in this volume is certainly Hawking's short introductory chapter on Newton's *Principia* with his acclaim of Newton as "the greatest figure in mathematical physics and the *Principia* [as] his greatest achievement" (p. 4). Equally interesting is Stephen Weinberg's reflection about Newtonianism as a research programme guiding the evolution of science for centuries. Newton's vision of a "comprehensive quantitative understanding of all of nature" (p. 10) is still at work in the most recent attempts to give a coherent theory of gravity in intimate connection with all other known forces in superstring theory. Another bold historical jump is exercised by Roger Penrose, who speculates about "Newton's corpuscular-undulatory view of light" from today's perspective of wave-particle duality and the picture of reality given by modern quantum theory.

This book will serve as a valuable reference source of the horizon of knowledge and its historical background for both active physicists and historians of modern physics; its contributors demonstrated the open border between both disciplines by transforming experts' knowledge into preliminary history of fields still *in statu nascendi.*

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