but reaction kinetics not at all, and those long charts of nuclear species and accompanying reaction-balancing exercises that abound in most elementary treatments are mercifully absent.

This concentration on fundamental concepts leads ultimately to an exposition of strong-interaction symmetries and classification schemes for elementary particles and reaches its conclusion with a brief discussion of quarks. All this is, to say the least, descriptive and heuristic; but the spirit and basic ingredients of this frontier of modern physics are quite faithfully conveyed. A final chapter on cosmology and cosmological models is straightforward and well done but misses the excitement of recent observational developments, though the cosmic blackbody radiation is described in an aside.

Some of the many exercises that follow each chapter are routine old chestnuts and are hardly likely to illuminate, but others are thought provoking and ingenious. Answers are not given. The mathematics used may, in places, be a bit demanding for underprepared students, but there is little emphasis on formula derivation and symbol manipulation, and the more difficult developments can be explained qualitatively in terms of elementary algebra by an alert instructor.

For the intelligent and well motivated, but scientifically unsophisticated, nonspecialist this account of physics as seen by an able physicist is superbly done.

But many of the needs with which this discussion began are left unmet. The book will not repay careless or hurried study, it will not catch the attention of the unmotivated and will be difficult going, despite Adair's colloquial style, for individuals of only moderate mental acuity. There is precisely no discussion of the way in which the practice of physics is embedded in our society and is influenced by external social forces.

Although the student learns wonderfully well what physicists think about when they are thinking physics, he learns almost nothing that will enhance his understanding of the meaning of physics for everyone else. That the historical development and cultural concomitants of physics are left out entirely runs precisely counter to the belief that these are the essential ingredients of physics for the nonspecialist. (That belief made much more sense, however, when college enrollments were smaller and more elite, and nonspecialists were likely to become academic scholars.) More compelling is that no effort is made to show the linkage of scientific activity generally and physics in particular with critical problems of the modern world. It is easy to argue that such efforts belong in some other course. But the other course usually does not exist.

In a cursory discussion of nuclear fission, Adair ignores nuclear weaponry and the nuclear balance of terror that has held the world in strategic stasis for the past 20 years. In discussing fusion he gives little indication of the benefits that might accrue to an energy-hungry world were fusion power to become a reality. The world of solid-state physics, (an *application*, after all, of quantum mechanics) is not even mentioned, despite its vast and continuing contribution to the complexities of modern technology. Adair's world of physics remains dry and sterile—in a word, academic. The modest paragraphs on the meson and baryon octets give no hint that these were discovered over a number of years through the expenditure of perhaps $1000 million of public funds, provided in the general expectation that better power sources or more powerful weapons would result. Adair gives no indication that the externalities of his science today are any different than they were in the days of Lord Kelvin. This failing is shared, in whole or in part, by virtually all his competition, and Adair's book, despite its many virtues as an exposition of science, still falls short of providing the education in physics needed by tomorrow's intelligent citizen.

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The reviewer's interest in "physics for the nonphysicist" developed from a three-year stint of teaching nuclear physics to officers and enlisted men bound for duty in nuclear submarines. He is presently head of the Office of Interdisciplinary Research at the National Science Foundation.

Through Rugged Ways To the Stars

By Harlow Shapley
180 pp. Scribner's, New York, 1969. $6.95

After Harlow Shapley retired from the directorship of the Harvard College Observatory in 1952, he was approached by Charles Scribner's Sons about writing his autobiography. Shapley had kept no written material except his technical books and papers, which were hardly sufficient for an autobiography. However, several years before he had spent two days being interviewed about his life and these interviews were tape recorded. This book is the result of transcribing these taped interviews, and therefore has an informal and lively conversational style that is truly entertaining.

Shapley received his PhD in astronomy in 1913 from Princeton, under the direction of Henry Norris Russell, and was then appointed to a position at Mt Wilson Observatory at Pasadena, Calif. He began his work just as the famous 100-inch reflecting telescope at Mt Wilson was being brought into use and was one of its original users. His career extends from then to the present when astronomy has become space science, utilizing such tools as radio astronomy.

After describing Shapley's childhood, the first chapter briefly outlines his precollege experience as a reporter for small newspapers in southwestern Missouri and southeastern Kansas, but is principally concerned with his experiences at the University of Missouri, which he entered in 1907. He intended to study journalism, but found that the school was not yet open, so he examined other courses. He could not pronounce a-r-c-h-e-o-l-o-g-y but could pronounce a-s-t-r-o-n-o-m-y; he graduated in 1910 with an AB in astronomy.

He then went to Princeton with a Thaw Fellowship in Astronomy. His dissertation was a basic contribution to the understanding of the Cepheid variable stars.

In chapter four the author reminisces about his work at the Mt Wilson Observatory. He was appointed to the staff in 1914, and his research there was concerned almost from the first with the distances of the Cepheid variables, which resulted in an outline of the structure of the universe. In this chapter appears a number of the great astronomers of the time, among them George Ellery Hale, W. W. Campbell and Edwin P. Hubble.

Also, during this time Shapely became interested in ants, and wrote some papers on them, but he is much better known as an astronomer than as a student of ants.

Chapter six is titled "The Great Debate." Heber D. Curtis of the Lick

Observatory did not accept Shapley's method of measuring great distances in the university. At Hale's suggestion, Shapley and Curtis presented papers and discussions at the meeting of the National Academy of Sciences in Washington on 26 April 1920. Curtis, soon after the "debate," accepted Shapley's ideas.

More important to him than this "debate" were the discussions in Washington that led to his appointment as the director of the Harvard College Observatory and Paine Professor of Astronomy in 1921.

Shapley then describes the scientific aspects of his work as director. The staff was increased and improved, research programs new to the observatory were started, and a program of instruction leading to the PhD degree was set up. A number of leading astronomers of the present received their training in this program. One of the major accomplishments of this period was the relocation of the southern-hemisphere station of the Harvard College Observatory from Peru to a site near Bloemfontein in South Africa.

In the remaining four chapters, the author briefly describes his extracurricular activities, international contacts, and his experience in mixing science and politics.

Shapley's brief comment on the changes that have taken place in astronomy should be noted: "Astronomy has changed so rapidly in recent years, on account of the invasion on space science, that my astronomy of the 1920's has become old-fashioned, and I am at times embarrassed about it, even though I do know some things and can talk fast enough to get away with being ignorant."

This book will provide highly informative and entertaining reading for an evening or two; reading it is highly recommended.

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Essays in the History of Mechanics

By C. Truesdell
383 pp. Springer-Verlag, New York, 1969. Cloth $4.95 paper $1.45

A recognized authority in his fields, C.Truesdell has here collected eight of his lectures, delivered between 1950 and 1967, and has equipped them with carefully chosen references and large number of relevant illustrations, from simple diagrams to stimulating halftone portraits and facsimiles from original papers.

Perhaps the most fascinating part of the book is its first quarter, devoted to a new assessment of Leonardo da Vinci's achievements. Here we find documented discussions of questions like "Did Leonardo experiment?" Also discussed is his work on early engineering, beams, force and motion, fluid mechanics, waves and vortices, plus his method of inquiry, his attitude to tradition and to science and art in general, with a concluding section on Leonardo's fame. About 30 of the book's best illustrations stem from Leonardo's diaries, which are critically examined by the author, often with quite uncompromising decisiveness.

This study is succeeded by a number of equally critical explorations, for instance the "Program Towards Rediscovering the Rational Mechanics of the Age of Reason;" the "Reactions of Late Baroque Mechanics to Success, Conjecture, Error, and Failure in Newton's Principia;" the "Creation and Unfolding of the Concept of Stress;" the problem "Whence the Law of Moment of Momentum?"; the early kinetic theories of gases; the reactions of the history of mechanics upon modern research, and, finally, on some recent advances in rational mechanics.

The hoped-for echo of the book can not be better indicated than by the author's own remark: "If these lectures find any favor with professional historians of science, I shall be humbly thankful for their toleration of a book not intended for them . . . ." There are some historians, Truesdell says, who remind him "of those taxonomers, perhaps of only fabulous existence, who cannot recognize a particular plant unless they see a sprig of it dead, dried, and pasted to a sheet of paper. For me, mathematical science is alive today, alive not only in its freshest leaves but also in its branches that reach down to the past. I know young men who have read the words of Gibbs and Kelvin and Stokes and Cauchy, even of Euler and Newton . . . in search of understanding and method, revealed by the speech of giants untranslated by pygmies. For such men, such scientists of our own day, these lectures were composed and are here printed."

ARTHUR BEER
Cambridge University

HARLOW SHAPLEY at his famous rotating desk at the Harvard College Observatory during the mid 1940's (Photo courtesy of Niels Bohr Library.)

Cours De Physique Générale: Thermodynamique

By G. Bruhat
888 pp. Masson, Paris, 1968. 98F

Georges Bruhat's five-volume treatise of physics at university level has been a classic in France and French-speaking countries for years, so much that its