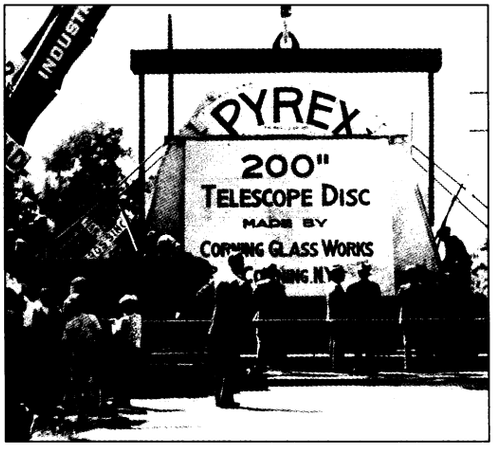
and with false starts and triumphs, culminating in an instrument that remained the biggest and best of its kind for decades. As Ronald Florence puts it, this mammoth project, like the 100-inch Mount Wilson telescope that preceded it, was on the scale of a battleship with the precision of a microscope, all designed to cradle and aim an ounce of silver (or aluminum in the case of the 200-inch) to catch a bit of starlight. Helen Wright has described the hero of the story, George Ellery Hale, in her recently reprinted biography *Explorer of the Universe* (1966; AIP Press, 1994), and Donald Osterbrock has approached the story from the angle of both Hale and G. W. Ritchey in his *Pauper and Prince* (University of Arizona Press, 1993). The originality of Florence's book lies in the concentration on the telescope itself: the extraction of $6 million from J. D. Rockefeller's International Education Board in 1928; the abortive attempt by General Electric over the next three years to build a fused quartz mirror; Corning's success (on the second try) in 1934 at building a ribbed Pyrex mirror, almost swept away by flood during the annealing process; the cross-country trek from New York to California to the cheers of throngs of citizens; the 11-year, 180,000 man-hour task, interrupted by World War II, of grinding and polishing the mirror to an accuracy of a few millionths of an inch; the innovative design of the mounting, telescope structure, dome, and instruments on a scale never before achieved; the many adjustments after first light in 1947, when some critics still predicted the telescope would never work; and finally the dedication of the instrument in 1948 and its transfer to fully operational status in October 1949.

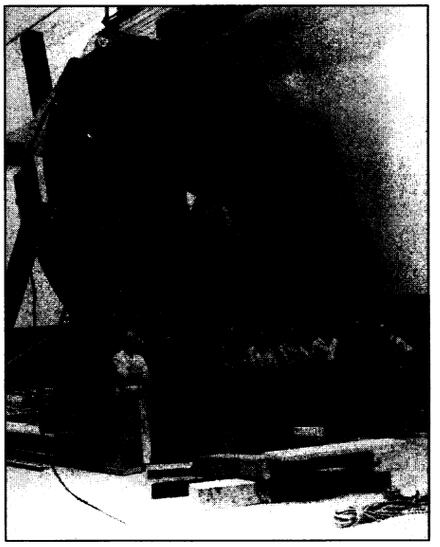
A few other books have described the building of the telescope, but no one has succeeded in describing so colorfully the details of the work and the personalities who undertook it against all odds. Florence describes how Hale himself had long suffered from a condition characterized by "a ringing in his ears and an agonizing headache, then physical exhaustion, a tingling in his feet, frantic excitement, insomnia, indigestion, spastic colitis, and the sensation that his mind was whirling out of control," not to mention visions of a little man who offered unwanted advice. Despite all this, Hale managed a significant research career in solar astronomy, was responsible for building the 40-inch Yerkes refractor (1897) and the 60- and 100-inch Mount Wilson reflectors (1908 and 1917), cofounded the California Institute of Technology, and founded the *Astrophysical Journal*, among other accomplishments. And he is only one of the many personalities brought to life in this volume.

Unfortunately, well written as it is, the book suffers from the serious flaw that some of its facts are plain wrong. To take only one episode, by way of background the first two chapters describe the Great Debate between Harlow Shapley and H. D. Curtis on the size and structure of the universe, which took place in Washington in April 1920, sponsored by the National Academy of Sciences. Florence repeatedly states that the debate happened in April 1921 (even making that date the title of his first chapter). He describes in colorful detail the cars arriving at the portico of the Smithsonian Castle for the event. However, the debate took place in the main auditorium of the Smithsonian's Natural History Building (where in April of this year another debate will be held to mark the 75th anniversary of the event). And Florence has Einstein in the audience, though Einstein did not make his first trip to the United States until 1921. It is one thing to quote a wrong date occasionally; it is quite another to build two chapters around that erroneous date, especially when the facts are well known from primary and secondary sources, some of which the author cites. More generally, these errors do not inspire confidence in the author's detailed account of the building of the 200-inch, details that are in many cases taken from archives and less easily checked. The book is therefore more successful as a historical novel than as history. In history, as in science, clarity of expression is laudable, but it is no substitute for accuracy.



The disk for the Mount Palomar telescope arrives at Pasadena. [From *The Perfect Machine*; California Institute of Technology Astrophysics Library]

The shortcomings of this volume should not diminish the importance of the dramatic story of Palomar—a story repeated (with a less successful ending) with the completion of the 6-meter telescope in the Soviet Union in 1975 and now being played out on many fronts as telescopes vie with one another for their grasp of starlight. A veritable boom of 6- to 10-meter telescope–building is currently under way, using a variety of new technologies. Already the 10-meter segmented mirror of the Keck telescope on Mauna Kea has surpassed both Palomar and the Russian 6-meter, with even larger mirrors on the way, including the innovative spin-cast honeycomb mirrors. Decades from now, these achievements will also have their stories told, it is to be hoped with both the color of the science writer and the accuracy of the historian.



The disk on its storage easel after being unloaded in Pasadena. [From *The Perfect Machine*; Mel Johnson]

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Small Bodies in Space

Asteroids, Comets, Meteors 1993. A. MILANI, M. DI MARTINO, and A. CELLINO, Eds. Published for the International Astronomical Union by Kluwer, Norwell, MA, 1994. xxxiv, 503 pp., illus. $147.50 or £100 or Dfl. 250. From a symposium, Belgirate, Italy, June 1993.

The average attention span for an individual on a given subject is said to be about 20 minutes. This explains why I fall asleep in seminars; why Haydn wrote the Surprise Symphony; and why I recommend the book *Asteroids, Comets, Meteors 1993*. This book is a compendium of review talks each of

Vignette: A Community of Scholars

I found myself in the most unstandard, and the most difficult, academic environment yet: the Institute for Advanced Study in Princeton, New Jersey. . . .

From the very beginning, the idealized nature of such a picture of the ultimate academy, a place where mind met mind and passion, self, and ignorance were absent, came under a certain amount of question. . . . Alongside . . . transcendent scholars tranquilly conversing in simple surroundings, . . . there developed the sort of highly personalized academic politics such a collection of luminaries set free from real-world constraints to rub up against one another might be expected to produce. . . .

A series of bitter, what's mine is mine, what's yours is negotiable quarrels led to chronic discord—quarrels over appointments, quarrels over the formation of schools within the Institute . . ., and, of course, quarrels over salaries, then as now too small for demigods, too large for publication. Tensions between faculty and directors, directors and trustees, and trustees and faculty, as well as between all of them and the philanthropists who had endowed the institution in the first place . . . developed and spread. . . .

All this internal warfare was, as far as I was concerned, so much prehistory when I arrived. . . . But it rather soon became clear that if past is prologue anywhere, it is at the Institute, which less transcends its crises than, reproducing its culture with a fidelity that would make the Tibetans envious, reenacts them.

—*Clifford Geertz*, in *After the Fact: Two Countries, Four Decades, One Anthropologist* (Harvard University Press)

which covers a different aspect of the science of small solar-system bodies. Many offer a historical perspective on the subject, describing the history and development of the field. But, best of all, none is long and pedantic. A professional or an advanced student interested in solar-system science will find each chapter to be a thorough introduction to its subject with useful reference material.

The subjects covered range from ground-based asteroid and comet detection techniques to spacecraft observations, both recent (Galileo, Ulysses) and proposed (Rosetta), of asteroids, interstellar and interplanetary dust, and comets. Significant effort is made to show the connections among different solar-system small bodies, meteorites and cosmic dust samples, and the interstellar medium. I particularly enjoyed the description of the newly discovered trans-Neptunian objects in the Kuiper Belt by Luu and the discussion of the possible connection between molecular components of comet material and interstellar dust by Greenberg and Shalabiea.

I got a thorough grounding in the different theories behind the dynamics in the solar system governing the removal of material from secular resonances with Jupiter's orbit and transport of meteorites to the Earth as discussed in chapters by Ferraz-Mello and by Froeschlé and Morbidelli. The dynamics of the Trojan asteroid clouds in Jupiter's orbit, now known to be a major asteroid reservoir, is covered by Milani.

One erroneous statement at the beginning of the chapter by Burbine and Binzel on asteroid reflectance spectroscopy should be noted. The visible spectral region contains more information about the surface mineralogy than simply the three spectral attributes discussed by the authors. The narrow-band spectrophotometry of asteroids afforded by the charge-coupled device/spectrograph combinations described in their chapter can delineate finer spectral features, which have in fact been identified by other researchers. Regardless, this chapter reviews some recent intriguing results in the reflectance spectrophotometry of asteroids, including tracing of the origin of the basaltic achondrite meteorites from Vesta to the 3:1 Kirkwood gap to the Earth through the reflectance characteristics of Vesta-family asteroids. The utility of reflectance spectrophotometry as a strong adjunct is again demonstrated in the chapter by McFadden reviewing evidence that ties asteroids and comets together in the search for the transition between the two types of small bodies.

Scientists studying small solar-system bodies will be interested in the last eight chapters, which describe different databases of interest, including asteroid spectral reflectance data, updated orbital element sets, albedos, light-curve photometry, rotation rates, and pole orientations. The goal of the organizers of the symposium at which these papers were originally presented was to make individual evolving databases accessible to scientists and to keep these databases physically separate. Most of these chapters have instructions for accessing these data through anonymous file-transfer protocol or internet connections. So I tried them out. And they work. I have discovered what other planetary scientists will discover: This book is a treasure trove of information and data on asteroids, comets, and meteors.

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Books Received

AAAS Science and Technology Policy Yearbook 1994. Albert H. Teich, Stephen D. Nelson, and Celia McEnaney, Eds. American Association for the Advancement of Science, Washington, DC, 1995. xii, 447 pp., illus. Paper, $24.95.

Advances in Electromagnetic Fields in Living Systems. Vol. 1. James C. Lin, Ed. Plenum, New York, 1994. vii, 196 pp. $69.50.

Aging of Cells, Humans and Societies. Ian K. Ross. Brown, Dubuque, IA, 1995. x, 229 pp., illus. $42.77.

American and Chinese Perceptions and Belief Systems. A People's Republic of China-Taiwanese Comparison. Lorand B. Szalay *et al.* Plenum, New York, 1994. x, 270 pp., illus. Paper, $69.50. Cognition and Language.

Animal Cell Technology. Basic and Applied Aspects. Vol. 6. T. Kobayashi, Y. Kitagawa, and K. Okumura, Eds. Kluwer, Norwell, MA, 1994. xvi, 615 pp., illus. $262.50 or £172.50 or Dfl. 410. From a meeting, Nagoya, Japan, Nov. 1993.

Babies in Bottles. Twentieth-Century Visions of Reproductive Technology. Susan Merrill Squier. Rutgers University Press, New Brunswick, NJ, 1995. xvi, 271 pp., illus. $48; paper, $17.

Bacterial Diversity and Systematics. Fergus G. Priest, Alberto Ramos-Cormenzana, and B. J. Tindall, Eds. Plenum, New York, 1994. viii, 331 pp., illus. $95. Federation of European Microbiological Societies Symposium Series, no. 75. From a symposium, Granada, Spain, Sept. 1993.

Baculovirus Expression Systems and Biopesticides. Michael L. Shuler *et al.*, Eds. Wiley-Liss, New York, 1994. x, 259 pp., illus. $85.

Basic Ideas and Concepts in Nuclear Physics. An Introductory Approach. K. Heyde. Institute of Physics, Philadelphia, 1994. xx, 424 pp., illus. $142.50 or £95; paper, $49 or £32. Fundamental and Applied Nuclear Physics Series.

Carnegie Atlas of Galaxies. Allan Sandage and John Bedke. Carnegie Institution, Washington, DC, with The Flintridge Foundation, 1994. 2 vols. viii, 750 pp., illus. $95.

Case Studies in Abnormal Psychology. Thomas F. Oltmanns, John M. Neale, and Gerald C. Davison. 4th ed. Wiley, New York, 1995. viii, 407 pp. Paper, $34.95.

Cell Biology. A Laboratory Handbook. Julio E. Celis, Ed. Academic Press, San Diego, CA, 1994. 3 vols., spiralbound, boxed. Vol. 1, xxxvi, 683 pp., illus., + plates. Vol. 2, xxviii, 496 pp., illus., + plates. Vol. 3, xxx, 535. pp., illus., + plates. The set, $99.

Cell Signal Transduction, Second Messengers, and Protein Phosphorylation in Health and Disease. A. Martin Municio and M. Teresa Miras-Portugal, Eds. Plenum, New York, 1994. x, 256 pp., illus. From a symposium, El Escorial, Spain, July 1993.

Cellular Proteolytic Systems. Aaron J. Ciechanover