



The lunar farside photographed from the Apollo 8 spacecraft. Despite long centuries of observation, much of the Moon remained unknown until space exploration began in the 1960's.

lunar-sample-analysis fraternity. His book is a review. With a large volume of material to cover, it is a review with a point of view, stressing interpretation, not data presentation. In language and style readily grasped by the nonspecialist and supplemented by an extensive glossary, ample footnotes and an index, he presents the post-Apollo understanding of lunar geology, both surface and interior.

From dim beginnings, perhaps glimpsed in the lunar-like markings on a reindeer bone carved over 300 centuries ago by a paleolithic hunter, to the megalithic astronomical observatories built around 40 centuries ago, to the first telescopic view 366 years ago, lunar science had evolved by the mid-twentieth century into an almost static, limited state characterized by detailed three-dimensional cartography and dating by stratigraphy and crater counts from Earth-based observations. Then over a period of eight years a quantum jump of unprecedented magnitude occurred. A program of intensive lunar study started in 1964 with photography from space platforms, which provided over 3,000 closeup images, followed by seven unmanned, self-landed scientific instrument packages. The program was completed in 1972, after six manned missions had left arrays of scientific instruments on the Moon's surface and returned with nearly 400 kilograms of lunar samples. A measure of the results of this program is provided by the over 30 000 pages of scientific literature it generated. The implied rate of publications has scarcely changed, finding outlet in a Moon-dedicated

journal and in books such as this one.

Separate chapters of Taylor's book describe the structure, composition and history of the regolith (the lunar-wide surface blanket of impact ejecta, surprisingly heterogeneous on the local scale), the maria (regions of lava extruded from depths of between 100 to 300 km at various times 3.2 to 3.9 aeons ago and giving rise to the gravitational anomalies called "mascons"), and the highlands (the oldest exposed areas on the surface, fully saturated with craters from the early $\frac{1}{2}$ to 1 billion year epoch of high meteor flux). These chapters emphasize the chemical interpretation of returned samples, and they feature striking scanning-electron-microscope views of glass beads and crystals, appropriately alien in appearance. Maria and highland chemical compositions differ in important details from petrologically similar earth rocks and from the standard of primitive solar system material — carbonaceous chondrites — which places hard constraints on theories of origin. The notion of a hereditary link between tektites and the Moon has been killed by revealed differences in composition. Moon rocks are deficient in volatile and siderophile (gold, silver and platinum group) elements and enriched in refractory ones. No evidence has been found for the presence of water or biogenic carbon compounds. Long exposure to the solar wind and to cosmic rays, it is evident, has left tracks and damaged grain surfaces.

The treatment of the surface exposure to the cosmic environment took the author away from his field and closer to

mine with no loss of depth or accuracy apparent to me. This thoroughness also characterizes the chapter on the interior, in which Taylor describes the results of seismic and electromagnetic soundings, remnant magnetism, and heat flux measurements. The derived structure is simpler than Earth's—nearly constant density with a core confined to less than 8 percent of the volume (and possibly absent). Structure exists, as is revealed by changes in seismic waves passing through different depths, but nothing appears beyond likely changes in rock composition consistent with the geochemical and geophysical data.

The origin of the Moon is still a mystery, but the Apollo program greatly altered our perception of the problem. Of the three main hypotheses—double planet, fission and capture — none has survived the Apollo data flood in original form. Mutants and hybrids are now emerging, but, as Taylor notes in the final chapter, the new geological, chemical, physical, petrological and chronological constraints make a fierce climate for the new hypotheses' existence. In the spirit of Darwinian positivism, the future looks promising; when the struggle between hypotheses to match the facts is finished, only one should survive.

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new books

Elementary Particles and Fields

Physique Subatomique: Noyaux et Particules. L. Valentin. 606 pp. Hermann, Paris, 1975. 98 F

Nuclei, Nuclear Physics

Lecture Notes in Physics, Vol. 40: Effective Interactions and Operators in Nuclei (Proc. of Int. Topical Conf. on Nuclear Physics, Univ. of Arizona, Tucson, June 1975). B. R. Barrett, ed. 339 pp. Springer-Verlag, New York, 1975. \$12.90

Materials and Solid State

Electrons in Metals: An Introduction to Modern Topics. C. M. Hurd. 331 pp. Wiley, New York, 1975. \$19.50

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Instrumentation and Techniques

Laboratory On-Line Computing. J. E. Brignell, G. M. Rhodes. 297 pp. Halsted, New York, 1975. \$24.50

Optica Electronica. G. Alexandru. 268 pp. Editura Academiei Republicii Socialiste Romania, Bucharest, 1975.

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Philosophical Papers, Vol. 1: Mathematics, Matter and Method. H. Putnam. 328 pp. Cambridge U. P., New York, 1975. \$19.50

Philosophical Papers, Vol. 2: Mind, Language and Reality. H. Putnam. 457 pp. Cambridge U. P., New York, 1975. \$25.00

Science in Flux. J. Agassi. 553 pp. Reidel, Boston, 1975. \$48.00

Popularizations

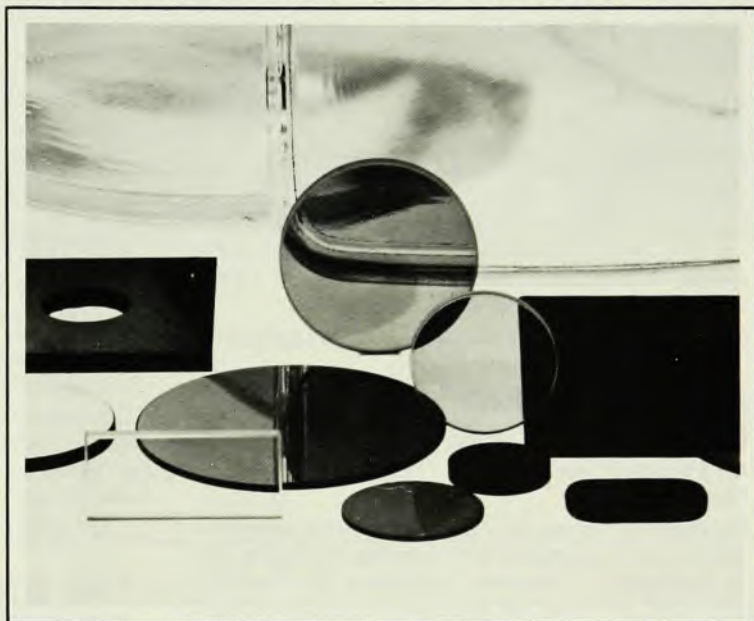
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