the study (1967–68). Those few cases which do overlap were not "explained" in the Condon report. Indeed, according to Hynek, about one-quarter of the cases selected by Condon remain unexplained, a seemingly significant fact not emphasized by Condon.

Hynek divides his 80 cases into six observational classes: Daylight Discs, Nocturnal Lights, Radar-Visual, and Close-Encounters of the First, Second, and Third Kinds. The first two categories are virtually self-explanatory. Hynek emphasizes the similarity in detail of the many sightings, such as the absence of a sonic boom despite great observed speed. Radar-visual reports, often generated by trained airport personnel who simultaneously made radar and visual sightings, would seem to be difficult to dismiss solely as anomalous radar propagation phenomena. All in all, it does not strain one's physical imagination intolerably to think of the first three classes as *possibly* understandable.

On the other hand, the Close-Encounters, in which a flying saucer-like object is stated to have been observed at close range, are obviously quite difficult to accept at face value. Hynek implicitly acknowledges this increasing credibility gap by his threefold subdivision. Close-Encounters of the First Kind involve the reported observation of such an object at a range of perhaps 20 to 500 feet. In Close-Encounters of the Second Kind the observer reportedly perceived a physical manifestation of the presence of the object; interference with auto ignition and lights is listed as a common effect, but thermal and physiological effects are also reported. Finally, in Close-Encounters of the Third Kind humanoid figures are reportedly observed as well. Hynek draws the line at this point, stating that those additional reports in which actual communication with such humanoids is claimed generally come from individuals who manifest psychological aberrations (unlike the great preponderance of those who report the less bizarre UFO categories). In fact, Hynek obviously feels uncomfortable about including Close-Encounters of the Third Kind because of the "little green men" implications.

Yet it is just here that the weaknesses in Hynek's own approach become evident. *Any kind* of Close-Encounter is bizarre—so why rule out just the most bizarre? Is Hynek afraid of the apparent implication of his own analysis—namely, that all the UFO phenomena really may be related to the Close-Encounters, and perhaps to flying saucers and little green men? Indeed, it would appear that this staggering implication drove the late James McDonald of the University of Arizona to actual belief in extraterrestrial visitation, a sort of modern replay of Percival Lowell's intelligent-life-on-Mars theme. Hynek does not deal adequately with the crucial question of how homogeneous a population the phenomena under discussion really are, and therein may lie his greatest vulnerability. Perhaps over the decades of his preoccupation with UFO's he has fallen victim to the natural tendency of a scientist to impute unity to his subject, even if nature is actually not so simple. However, Hynek remains a dedicated empiricist, despite his uneasiness about the Close-Encounters, and maintains that the existence of new empirical observations is indeed strongly suggested by the collection of thoroughly investigated but still unexplained UFO reports. His plea therefore is for sufficient scientific respectability for the UFO subject to permit modest federal research funds to be awarded to it and new data to be gathered without fear of ridicule.

On balance, Hynek's defense of UFO's as a valid, if speculative, scientific topic is more credible than Condon's attempt to mock them out of existence. The fact that Hynek was granted no NASA or NSF support *at all* for study of UFO's can be regarded as a rather dismal symptom of the authoritarian structure of establishment science. It is also disappointing that *Science*, which has earned the respect of U.S. scientists and occasionally the enmity of U.S. bureaucrats by providing an independent forum for controversial views, failed to publish a responsible rebuttal to the Condon report, treating it instead as a news item. As a result, the substantial criticisms raised by Hynek now were not adequately aired then. Thus, from this juror's point of view at least, Hynek has won a reprieve for UFO's with his many pages of provocative unexplained reports and his articulate challenge to his colleagues to tolerate the study of something they cannot understand.

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Reference

1. *Scientific Study of Unidentified Flying Objects.* Conducted by the University of Colorado under Contract to the United States Air Force. Edward U. Condon, Scientific Director. Daniel S. Gillmor, Ed. Published in association with Colorado Associated University Press by Dutton and as a New York Times Book by Bantam, 1969.

Metal Deposits

Ore Petrology. R. L. STANTON. McGraw-Hill, New York, 1972. xviii, 714 pp., illus. $19.50. McGraw-Hill International Series in the Earth and Planetary Sciences.

A few metallic elements, notably iron, aluminum, and manganese, are abundant in the earth's crust and are easily concentrated by natural processes into large accumulations of commercial value. In contrast, the development of ore bodies containing elements that normally are found only in trace amounts in rocks requires coincidence in time and space of an unusual succession of geologic events. An understanding of the natural histories and the changing physical-chemical controls that have produced ore bodies throughout the geologic past has a very practical application in the continuing and accelerating search for new, untapped sources of metallic wealth. Most of the land surface and the ocean floor is underlain by rocks or unconsolidated accumulations of rock and mineral debris that are essentially barren of economically recoverable valuable metals, and efficient exploration accordingly requires recognition and location of target areas where geologic conditions are likely to be favorable for concentration of metals.

The author of this book views ores as polymineralic rocks, hence the title. Their crystallization is regarded as being determined by the same physical-chemical controls that have been so extensively studied and interpreted by metallurgists and ceramists. The author reveals a strong bias against interpretation of textures of ore deposits as a consequence of replacement (metasomatism) where it is possible to find alternative explanations. This bias is evident in his statement that "it seems likely that at least many of the structures ascribed to replacement up to about 1955 are due to simple grain growth, precipitation, annealing; and so on."

One of the most successful approaches to the location of target areas

where economic new deposits of metals might be discovered utilizes the vast amount of information recovered during the extraction of known ore deposits. The author is fully aware that this is so and has systematically documented the characteristics and debates concerning genesis of the many important rock associations that have yielded ore deposits throughout the world.

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Plant Processes

Photosynthesis, Photorespiration, and Plant Productivity. ISRAEL ZELITCH. Academic Press, New York, 1971. xiv, 348 pp., illus. $15.

Photosynthesis and Photorespiration. A conference, Canberra, Australia, Nov. 1970. M. D. HATCH, C. B. OSMOND, and R. O. SLATYER, Eds. Wiley-Interscience, New York, 1971. x, 566 pp., illus. $19.

These books deal with a subject of great current interest to plant scientists. The discovery of C_4 plants (those in which the early products of carbon dioxide fixation are four carbon dicarboxylic or amino acids instead of phosphoglyceric acid) and the realization that this biochemical difference was associated with altered habitat, anatomy, and physiology have provided a meeting ground for various botanical disciplines. Differences between C_4 and C_3 plants are of more than academic interest; the field productivity of C_4 plants is generally considerably greater than that of the classical C_3 plant. The reader may be interested to learn that crabgrass is a C_4 plant.

Surprisingly, the lesser productivity of C_3 plants is thought to be due to their respiring away, during illumination, a considerable portion of newly fixed carbon. This phenomenon, called photorespiration, is a major subject of both books, but the reader will look in vain for a rationale.

The book by Zelitch brings together most aspects of plant productivity. A section on chloroplast biochemistry, genetics, and photochemistry is followed by sections on photorespiration and productivity in single leaves and in stands. The book is a fine introduction to these subjects and will doubtless be valuable to students and research workers, for it combines topics which are related but are usually treated separately. Photorespiration and the C_4 pathway occupy a large portion of the text, which is of course not surprising, this being one of the author's research interests. The physical and morphological parameters of leaves which affect productivity are discussed, along with the nature of the stand. Metabolism of carbon compounds involved in carbon dioxide fixation and in respiration is given good coverage. The book covers a larger subject matter than do most books of its size, and therefore some areas are treated very briefly. In certain cases this is all to the good. For example, Zelitch seems to believe the triplet state is an obligatory intermediate in the photochemistry of photosynthesis; certainly nothing profitable could be achieved by a lengthy discussion of that matter. The book suffers from the author's adoption of the role of advocate rather than judge. Particularly on the somewhat controversial subject of photorespiration, evidence contrary to his viewpoint is often ignored or treated very lightly. In short, the book is a good introduction to several subjects but does not reflect the disparate opinion that actually exists about them.

Photosynthesis and Respiration is the proceedings of a conference. It is, in the main, devoted to C_4 plants and includes sections on adaptation, evolution, carbon dioxide assimilation, chloroplast structure, photorespiration, and the role of microbodies. It is an excellent publication, extremely easy to read for books of its type. Each section is prefaced by review papers and ends with assessments. Some excellent micrographs aid in understanding the complexities of C_4 plants. The book starts with fine reviews by Downton and Björkman which point out the anatomical and physiological differences between C_4 and C_3 plants. Björkman suggests that the C_4 pathway represents an adaptation to conditions of high temperatures and light intensity combined with limited water supply. Plants having this pathway photosynthesize more rapidly than do C_3 plants under atmospheric partial pressures of carbon dioxide and oxygen. C_3 plants can approach the C_4 rate if the partial pressure of CO_2 is increased or that of oxygen lowered, presumably because of suppression of photorespiration. The roles of glycolic acid and microbodies in photorespiration are discussed by several contributors. The section on carbon dioxide fixation is bracketed by Hatch, who introduces, and Slack, who assesses. The consensus is that C_4 plants fix carbon dioxide into dicarboxylic acids in the mesophyll cells and that these acids are transported into the bundle sheath cells, where they are decarboxylated and the liberated carbon dioxide is refixed via the Calvin cycle. As I read this volume shades of Warburg appeared to my mind; it seemed as if the late master were running things by some kind of remote control. The volume ends with a final assessment in doggerel.

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Nonmammals

Physiology and Biochemistry of the Domestic Fowl. D. J. BELL and B. M. FREEMAN, Eds. Academic Press, New York, 1971. In three volumes. Vol. 1, xxii pp. + pp. 1–602, illus., + index. $29.50. Vol. 2, xxii pp. + pp. 603–1152, illus., + index. $29.50. Vol. 3, xiv pp. + pp. 1153–1488, illus., + index. $23.50.

This set of volumes is unique because it is the first reference work on the anatomy, physiology, and biochemistry of the domestic fowl. There has long been a need for the authoritative coverage provided here. Those who as students or as seasoned investigators venture forth into avian physiology have, up to now, faced the time-consuming and frustrating task of locating pertinent articles hidden within a mountain of mammal-oriented literature.

The 53 contributors dedicated themselves to the task of assembling through 1970 these difficult-to-find publications, but they have done much more. They evaluate the publications of others in the light of their own extensive first-hand experience and supplement their own competency by drawing generously from the unpublished data and ideas of colleagues. Such cooperation was possible because almost all were based on the "tight little island," 35 in England, 14 in Scotland, and 2 in Northern Ireland; one contributor was located in New York City.

The group under the planning of the editors has produced a well-integrated and coordinated sequence of topics: digestive system, presented anatomically, physiologically, and biochemically; the same sequence for respiratory systems; chapters on energy, gaseous, carbohydrate, lipoid, acetate, and protein metabolism; and then chapters on the roles of the vitamins and trace