up now and then in particular localities. Lawrence is able to outline the five major stages in the evolution of the cargo belief in this region and to relate the theological features of each stage to indigenous pagan and to imported Christian doctrines. In his view, this structure of cargo belief is now a principal inhibitor of modernization among native peoples in New Guinea.

Lawrence in conclusion to this carefully documented study has some remarks (pp. 271–73) of relevance not only to the Australian administration of New Guinea, which he directly addresses, but also to Americans involved in the difficult business of combating heresy and introducing social reform in other countries:

> . . . it is useless to pour in 'aid' from air-conditioned offices without going outside to discover and take into account the people's own ideology and their likely reactions to what is being offered them . . . we must acknowledge and respect cargo ideology as a carefully integrated intellectual system which, as has been shown by its persistence over eighty years, is extremely durable.

But Lawrence at last concludes that it is necessary to "attack" the cargo ideology, albeit in a sophisticated way, by introducing "radical change in the economic field." Yet such change is the goal itself; cargo belief is instrumental, either negatively or positively, toward this end. Might it not be wiser, even if more trying, to work with it, to nurture it, to feed it, and to let more highly developed institutions grow from the cargo belief? A manifest aim of the cargo rituals is, in fact, precisely the achievement of "radical change in the economic field," and if the cargo movement does not depend on Western support, it will find that support in other parts of the world. The mere fact that the theology is bizarre does not mean that it cannot support a sophisticated technology and effective social institutions. Japanese political theology has sometimes appeared to be unreasonable, in Western eyes, but it did not inconvenience an extremely successful industrialization process; and today even some Western economists might take issue with Calvinist theology as being a trifle bizarre, yet by encouraging enterprise it contributed to the industrialization of Europe and America.

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Domesticated Plants and Evolution

Essays on Crop Plant Evolution. Sir Joseph Hutchinson, Ed. Cambridge University Press, New York, 1965. viii + 204 pp. Illus. $9.50.

Crop plant evolution is one of the most complex and rewarding fields of study. For many years de Candolle's *Origin of Cultivated Plants* was the only important publication in the field. The reports of Vavilov and his associates in the 1930's, on the kinds of cultivated plants and their wild relatives in many parts of the world, stimulated studies, and much work has since appeared in scattered publications. These essays, based on a series of lectures, summarize the recent research on origins and evolution of some important crop plants.

In the first chapter H. Godwin explains how pollen analysis provides evidence for prehistoric changes caused by man in the natural vegetation. Such evidence indicates that agriculture reached northwestern Europe about 3000 B.C., some 4000 years after it was practiced in Iraq and Iran.

Summaries of the archeological, cytological, genetical, and taxonomic evidence on the evolution of maize, wheat, barley, oats, rye, sorghum, potatoes, and forage crops condense essential data and studies on their evolution. Although the patterns of evolution differ, some striking similarities are revealed. Man's care and transport of cultivated plants and the continuing contact between crop plants and their wild relatives are shown to be important in the development of most of our domesticates.

Most food crops have been cultivated for centuries, but, with few exceptions, the deliberate cultivation of forage grasses and legumes has developed in comparatively recent historic times. J. C. Cooper has assembled data to show how these plants evolved under human selection, and he suggests how breeding might continue.

In the concluding chapter Hutchinson, the editor, points out that the rate of change in domesticated plants is greater than in any other group of plants. The vast resources of wild and cultivated plant materials we now have are material for changes "as great and significant for human welfare as those that have occurred in the past. Our limitations are the limitations of our scientific insight and imagination, rather than of the biological material with which we work."

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University Reviews in Biology Series: Biochemistry

The Metabolism of Insects. Darcy Gilmour. Freeman, San Francisco, Calif., 1965. xii + 195 pp. Illus. Paper, $2.50.

Just as the tiniest insect contains within itself, in perfect proportion, all of its essential organ systems, so this small and convenient book has packed within it, in well-balanced fashion, all the facts and hypotheses essential to present-day understanding of insect metabolism.

The book opens with a thorough discussion of energy metabolism, the first chapter being devoted to mechanisms of energy production, and the second, to those of energy utilization. These first two chapters set the tone of the entire work, which, while emphasizing the fundamental principle of biochemical unity, points out the fascinating biochemical diversity found among the insects. Thus, the wing muscles of insects that are capable of exceptionally rapid, vigorous flight are provided with giant mitochondria having a particularly efficient system for energy production. There follow chapters on carbohydrate and lipid metabolism; the metabolism of insecticides; the metabolism of amino acids; of purines, nucleic acids, pterins, and pyrroles; and of proteins; the final chapter is an up-to-date discussion of the control of metabolism. The chapter on lipid metabolism includes a most interesting section on hydrocarbons with special functions: the pheromones, those remarkable odors of communication, and the various defensive and aggressive secretions. The chapter on insecticides and their mode of action is of considerable general significance.

Only a few relatively minor defects are apparent. The bibliography might well have been made more extensive. Its 80 references include only a few reviews and chiefly recent articles from which (one hopes) it should be possible to trace back the relevant literature. In view of the role of vitamin A in keratinization in vertebrate tissue, the statement (p. 107) that it has no role apart from production of visual pigments may be questioned. It would have been of interest to include a discussion of the metabolic role (or of the little that is known about it) of the numerous symbiotic microorganisms of insects. But these are small matters compared to the positive values of this highly readable book.

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Radiation Research

Advances in Radiation Biology. vol. 1. Leroy G. Augenstein, Ronald Mason, and Henry Quastler, Eds. Academic Press, New York, 1964. x + 285 pp. Illus. $11.

Until recently there were no review series devoted especially to the biological aspects of radiation research. Now there are two; the one reviewed here, *Advances in Radiation Research*, and *Current Topics in Radiation Research*, which was reviewed in the 7 May 1965 issue of *Science*. It is regrettable that this duplication has occurred. Both volumes contain well-written articles, but there is certainly no need for two review series in this one field. It is also regrettable that the present series, which offers no more in content than the other, should be appreciably more expensive.

In the first article, on the radiation chemistry of aqueous solutions, Harold A. Schwarz gives a very clear, succinct picture of the present knowledge of the radiation chemistry of water. The evidence for various products of irradiated water is summarized and evaluated, and some emphasis is placed upon the importance of rate constants.

In another chapter Gordon Tollin provides an excellent review of the various physical processes in photosynthetic energy conversion. He discusses the absorption and emission of light, energy transfer, and electronic charge migration, with special emphasis on photosynthetic pigments in vitro. Attempts are made to relate these theories and observations to the energy conversion processes in photosynthesis, but they demonstrate the difficulty in making the connection between the simplified in vitro systems and the organized system in the cell.

Donald E. Wimber's chapter on intracellular irradiation with tritium should be read by all those who use this radionuclide for labeling purposes, for it is clear that the biological effects of the radiation from tritium are not negligible in many situations. Wimber gives a well-balanced account of the still rather scanty evidence on this problem.

The effects of small doses of radiation, in the order of a few tens of rads down to even fractions of a rad, are reviewed by Arne Forssberg. The information on this subject has been quite scattered, and it is valuable to have it brought together in a careful and critical review.

The chapter by J. Liebster and J. Kopoldová, on the radiation chemistry of amino acids, is a long and careful compilation of the many reactions for which there is some evidence; each amino acid or group of amino acids is discussed in turn. The chapter will probably be of great use to investigators in this field, but it will be less useful than the other chapters to those who want a succinct picture of a field other than their own.

In the final chapter, "The relative role of ionization and excitation processes in the radiation inactivation of enzymes," Leroy G. Augenstein, Tor Brustad, and Ronald Mason emphasize the theory of energy absorption and conversion processes. These authors make a particular point of studies on the temperature dependence of inactivation by radiation and point out the difficulties with the simpler ionization models for radiation action.

In general this is a well-written volume that will repay reading by anyone in the field.

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Erratum: In my review of *Principles of Dynamics*, by Donald T. Greenwood [*Science* **148**, 810 (1965)], I cited errors in Problem 5-9 and Eqs. (8-308). The author has shown me that he is in fact correct in both instances.—E. E. ZAJAC.

New Books

General

From Semaphore to Satellite. Anthony R. Michaelis. International Telecommunication Union, Geneva, 1965. 343 pp. Illus. $9.50.

Galileo: The Man, His Work, His Misfortunes. James Brodrick. Harper and Row, New York, 1965. 152 pp. Illus. $3.50.

Grasses of the Texas Coastal Bend (Calhoun, Refugio, Aransas, San Patricio, and northern Kleberg counties). Frank W. Gould and Thadis W. Box. Texas A&M Univ. Press, College Station, 1965. 197 pp. Illus. $3.25.

The Habitable Earth. Ronald Fraser. Basic Books, New York, 1965. 155 pp. Illus. $4.50. Science and Discovery Series.

Hegel: Reinterpretation, Texts, and Commentary. Walter Kaufmann. Doubleday, Garden City, N.Y., 1965. 498 pp. $6.95.

Human Diversity: The Nature and Significance of Differences among Men. Kenneth Mather. Free Press (Macmillan), New York, 1965. 134 pp. Illus. $5.95.

An Illustrated Elementary Classification of Minerals, Rocks, and Fossils. H. C. Curwen. Pergamon, London; Macmillan, New York, 1965. 195 pp. Illus. $6.50.

Industrial Wastewater Control. A textbook and reference work. C. Fred Gurnham, Ed. Academic Press, New York, 1965. Twenty-four papers on the following topics: Food products—Animal (4 papers); Food products—Vegetable (4 papers); Mining (3 papers); Mineral products (4 papers); Manufactured products (6 papers); and General industries (3 papers). Chemical Technology Series of Monographs, edited by Raymond F. Baddour.

Mental Retardation: Its Nature and Incidence. A population survey of the state of Delaware. Joseph F. Jastak, Halsey M. MacPhee, and Martin Whiteman. Univ. of Delaware Press, Newark, 1963. 204 pp. $6 (order from the University Bookstore, Univ. of Delaware).

Missions to the Niger. vol 1, *The Journal of Friedrich Hornemann's Travels from Cairo to Murzuk in the Years, 1797–98*; [and] *The Letters of Major Alexander Gordon Laing, 1824–26*. E. W. Bovill, Ed. Published for the Hakluyt Society by Cambridge Univ. Press, New York, 1964. 420 pp. Illus. $7.50.

The New Priesthood: The Scientific Elite and the Uses of Power. Ralph E. Lapp. Harper and Row, New York, 1965. 254 pp. $4.95.

On the Nature of Things. Lucretius. Wendell Clausen, Ed. Translated by H. A. J. Munro. Washington Square Press, New York, ed. 2, 1965. 205 pp. Paper, 60¢.

Physiatric Dictionary. Glossary of physical medicine and rehabilitation. Herman L. Kamenetz. Thomas, Springfield, Ill., 1965. 181 pp. $6.75.

Priestly Lectures. The 39th annual lectures (April 1965). pt. 1, *Chemical and Biological Studies with Deuterium* by Joseph Katz; pt. 2, *Chemistry in Liquid Metal Solvents* by Harold M. Feder, Phi Lambda Upsilon, Pennsylvania State Univ., University Park, 1965. 145 pp. Illus. Paper, $3.25.

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