who designed, ran, used, and were imprisoned in that sterile place. This book does not reveal enough of the decision-making processes to enable us really to understand why the LRL operates as it does. The NASA system, clearly dominated by engineers, can be frustrating for scientists who are more curious about the moon than they are interested in the means of getting there. Although some of these management conflicts surface in Cooper's record, they are never dissected to reveal who in the NASA administration is scientist or engineer, or for that matter how much in each of us is scientist or engineer. The trips to the moon and the aftermath are a truly interdisciplinary effort, and it seems unfortunate that some members of the team are unable either to absorb the detail or to learn the reasoning behind their colleagues' ideas.

Such criticism cannot be leveled at Mason and Melson, who have captured the better part of the Apollo 11 scientific results in their book, *The Lunar Rocks*. Mason has offered two earlier texts, on geochemistry and on meteorites, of high quality, and this volume maintains the high standards of clarity and objectivity characteristic of those earlier works. Melson's contributions are not easily distinguished from Mason's, and the book is a uniform, coherent entity.

We are given complete résumés of the mineralogy and petrography of the lunar rocks, and an element-by-element discussion of the chemistry of these rocks. There are abundant facts, photomicrographs, and some convenient summaries of data. For someone who has only a peripheral interest in the moon, this volume is recommended as an excellent summary of the data available as of January 1970. It is a little weak in describing the general context of the rocks sampled, and I think the discussions on isotope geochemistry, physical properties (excepting magnetism), and lunar stratigraphy are inadequate. I also think that the usefulness of elemental and isotopic abundances in rejecting or adopting lunar theories should be discussed in the context of those theories, rather than in a periodic encyclopedia of the elements.

Unfortunately, the volume is already obsolete. Lunar petrology is moving at a rapid pace. NASA has required fast publication of results, and the field is highly competitive. A similar text could be published every year throughout the next five years and become obsolete each year. I hope these authors will update their effort, for it is a useful book.

Whether there is a real need for such updating is dependent on decisions in the higher levels of government. It would seem that activities such as lunar exploration could be supported in times when 90 percent of us are not engaged in producing goods needed for survival. Moon workers help sate our curiosity, provide many and varied peripheral jobs, and are not especially wasteful of our natural resources. I am personally grateful to all of those workers, and these two books provide some explanations why.

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Bacterial Activity

Biochemistry of the Phagocytic Process. Localization and the Role of Myeloperoxidase and the Mechanism of the Halogenation Reaction. A symposium, Miami, Jan. 1969. JULIUS SCHULTZ, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1970. 142 pp., illus. $8.

When a leukocyte ingests a microbe its protective action against infection in the whole animal is expressed by its ability to kill the bacterium. At least a part of that bactericidal activity is due to one or another metabolic product of the phagocyte itself, as was revealed some years ago by Dubos with respect to lactic acid. In very recent years work from several laboratories has indicated that hydrogen peroxide might be a metabolic product with particularly important bactericidal activity. This is especially intriguing in at least one class of phagocytes, the polymorphonuclear leukocytes, where there is a very large amount of a particular peroxidase, myeloperoxidase. The function of this enzyme was not really known until quite recently. The chapter by Klebanoff in this volume, on myeloperoxidase-mediated bactericidal phenomena, summarizes the evidence for the participation of hydrogen peroxide, a halide (particularly iodide), and myeloperoxidase in a potent bactericidal system, ascribing a real and important function to the peroxidase. The enzyme has been known for some years to be localized in the intact cell in a lysosome-like granule which voids its contents into the phagocytic vesicle, that is, into the intracellular "chamber" in which the ingested bacterium is contained. While the source of the enzyme in the phagocytic vesicle or vacuole is known, the origin of the hydrogen peroxide is currently the subject of some controversy. The hydrogen peroxide is, however, widely considered to be formed by cytochrome-independent oxidation of reduced pyridine nucleotides. The availability of the latter increases during the metabolic burst that accompanies the ingestion of particles—bactericidal or otherwise.

Indeed, if one examines the whole process of phagocytosis, one is struck by the fact that the metabolic reactions that are stimulated as the cell ingests the solid object have three purposes. In the leukocyte these are: provision of energy for the ingestion process itself; provision of energy and building blocks for repair and maintenance reactions, for example at the cellular membrane; and provision of hydrogen peroxide for bactericidal activity. Our insight into these matters is now rapidly increasing, but it should be borne in mind that not all leukocytes have peroxidase-mediated bactericidal activity and that, even in the polymorphonuclear leukocytes, this system is almost certainly not the only one that attacks the ingested bacterium. The role of the phagocytins (basic proteins that are also granule-bound) which have been studied by Hirsch and Spitznagel, among others, must be taken into account.

The book contains some important and useful information, particularly for those working in the field of bactericidal activity or the peroxidases. The paper of Klebanoff already mentioned refers to a genetic defect in which, as far as one can now judge, the ability of the cells to produce hydrogen peroxide is deficient. In Martin Cline's chapter a hereditary situation is described in which the peroxidase of polymorphonuclear leukocytes is deficient. In both these circumstances microbicidal activity is depressed, presumably because these key components of the system are lacking. These two chapters are closest to the core of the problem defined by the book's title.

The chapter by Schultz and Berger on myeloperoxidase itself and the properties of the granule in which it is contained and that of Baggiolini, Hirsch, and de Duve concerning the general distribution of enzymes in leukocytic granule populations also relate closely to the phagocytic and bacteri-

cidal process because of the biological role of these granules and of the many enzymes they loose on the engulfed bacterium.

The chapter by Hager, Thomas, and Morris on a chloroperoxidase, which differs from myeloperoxidase in that it is able to chlorinate as well as iodinate substrates in the presence of peroxide, provides an interesting comparison with the leukocytic situation. That of Morrison, Bayse, and Danner on the role of mammalian peroxidase in iodination reactions amplifies the realization that the polymorphonuclear leukocyte has several similarities to thyroid cells. This has been hinted in the past from more general metabolic observations, such as the response of the thyroid to thyroid-stimulating hormone compared to the response of polymorphonuclear leukocytes to external particles they internalize.

As so often happens in collections of papers delivered at symposiums, the parts of the resulting book do not coherently form a crystalline whole. The chapter of Lehninger and Carafoli on calcium transport certainly cannot be faulted on its content or its importance. However, its inclusion in this particular volume is not easy to justify; it really does not seem germane to phagocytosis. Finally, the preface to the volume contains some statements that are not completely in accord with the views of some of the authors of the various chapters and that seem to be somewhat uncertain in the context of current experimental information.

Despite these remarks, this book does come at a fortunate time and will certainly stimulate interest in intracellular sequels of ingestion by phagocytic leukocytes, even if the larger theme envisaged by its title necessarily must await a more extensive treatment.

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Population Theory

Mathematical Topics in Population Genetics. KEN-ICHI KOJIMA, Ed. Springer-Verlag, New York, 1970. x, 400 pp., illus. $18.70. Biomathematics, vol. 1.

Ken-ichi Kojima has assembled a sort of "Festschrift for Everybody" in the field of theoretical population genetics. It is a mixture of review papers and original research papers. Their authors are among the most active researchers in the field.

There has been a shortage of good reviews that make the theoretical literature more accessible to newcomers. The reviews in this volume will go far toward filling this need, although they do not pretend to cover the field completely.

Sewall Wright reviews his "shifting balance" theory of evolution. Although Wright has not been reticent in stating his views in the past, this paper is valuable as one of the most concise and readable statements of his views on evolution. It also contains judicious comparisons of his theory with the views of Fisher and Haldane.

J. R. G. Turner reviews the work that has followed Fisher's fundamental theorem. His review contains an extensive exposition of the mathematics of changes in mean fitness.

R. H. Richardson reviews models of dispersion of organisms, the emphasis of the review being on comparisons of the models with real biological data. It is a sad comment on the gulf between theoretical and experimental population genetics that this paper seems almost out of place in the volume, purely because it is more concerned with realism than with precision.

J. F. Crow presents an extensive review of genetic loads, and Motoo Kimura reviews stochastic processes in population genetics. Kimura's review concentrates on diffusion approximations. A review by Henry Schaffer of work on branching processes and the survival of mutant genes complements Kimura's review by covering some of the work on the stochastic processes to which the diffusion equations are an approximation.

J. A. Sved and O. Mayo review recent theoretical work on the evolution of dominance. C. C. Li reviews segregation analysis of human sibship data, confining himself to the case of complete ascertainment of affected individuals. Kojima and Lewontin review linkage and epistasis in evolution.

If the reviews are highly useful, the original papers are fascinating. C. Clark Cockerham presents recurrence relations for inbreeding coefficients in systems of mating that avoid mating close relatives. His paper is an attempt to bring results in this area into a single picture.

Although there is no review paper covering quantitative genetics and animal breeding, two papers by W. G. Hill and Alan Robertson provide a view of the Edinburgh school at work. Hill and Robertson view animal breeding in terms of changes of gene frequencies at single loci, making extensive use of diffusion approximations. They are less interested in the gain from selection in one generation than in the ultimate probability of fixing favorable alleles in a line. Hill compares the effectiveness of different methods of selection by line-crossing. Robertson examines the effect of linkage on the gain from truncation selection when there are many loci. His paper is a demonstration of how far one can go beyond exact equations by a careful combination of approximations, computer simulation, and heuristic arguments.

Richard Levins provides the liqueur to this repast in a brief but important paper which is one of the first serious attempts to grapple with the problem of group selection.

In general, the quality of the contributions compensates for the high price of this volume.

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A Physical System

Three Body Problem in Nuclear and Particle Physics. Proceedings of an international conference, Birmingham, England, July 1969. J. S. C. MCKEE and P. M. ROLPH, Eds. North-Holland, Amsterdam, and Elsevier, New York, 1970. xii, 564 pp., illus. $32.

An ever-increasing number of theoretical and experimental papers has been published in recent years on various aspects of the three-body problem. Improved mathematical methods, such as Faddeev equations, improved computer technology, and new experimental techniques have given impetus to substantial research in this field. It was very fitting, then, that a conference be held to discuss the three-body problem. The proceedings of this conference, which was attended by some of the better-known workers in the field, contain 30 full-length articles and the abstracts of another 39 contributed papers. There are 16 theoretical and 11 experimental articles. In addition, three review papers, summarizing all avail-