Book Reviews

Fauna near the Limit of Tolerance

Entomology of Antarctica. J. LINSLEY GRESSITT, Ed. American Geophysical Union, Washington, D.C., 1967. xii + 395 pp., illus. $17. Antarctic Research Series, vol. 10. NAS–NRC Publication 1574.

In form, this book is a collection of 20 papers, equally divided between the systematic and ecological points of view; but in sum it is also an up-to-date review of our knowledge of the arthropod fauna of Antarctica. It results primarily from the work of the Bishop Museum (Honolulu) over the past ten years, with contributions also from British and Australian sources.

The terrestrial fauna of Antarctica is reduced and specialized. Apart from the birds and seals and their ectoparasites, the only other macroscopic animals—and the only ones depending on the resources of the land for their food—are some very small ground-living arthropods and three pterygote insects. There are 50 mites and 19 springtails, and two chironomid flies (only one actually with wings) and one nest flea. The contrast with the high arctic is striking. Even on Ellef Ringes Island, the most rigorous area yet studied, there are 17 chironomids and a dozen other pterygote species in three orders; and on Ellesmere Island and northernmost Greenland, at 82°N, there is a diversified fauna of higher insects of well over 200 species. Interest centers therefore on a fauna of land organisms that is approaching the ultimate limit of tolerance in the face of polar conditions.

The species of maritime Antarctica are related to subantarctic forms, and may have arrived, mainly via the Antarctic Peninsula, since the last glacial maximum. But the smaller fauna of Victoria Land and the interior stations is highly distinctive, and includes no less than seven endemic genera of mites and springtails. The authors agree that it may be the remains of the preglacial antarctic fauna, surviving on favored ice-free sites since Miocene times.

Maritime Antarctica has a moderate snowfall which yields water in summer, and at Palmer Station there are mossy areas that remain damp through the season and carry a fauna of about 16 species. But inland from McMurdo Sound the mean temperature of the warmest month never quite reaches 0°C, and in ice-free areas the meager snowfall is dissipated almost entirely by evaporation. H. Janetschek gives a very valuable account of the stringent conditions of life of this high antarctic fauna and makes several basic points. In summer the incident solar radiation is strong and continuous, and increases in total from the Antarctic Circle to the Pole; thus at the ground surface, and for several centimeters below, the temperature may be very much higher than that measured by the meteorologist. At 77° to 80°S, moreover, the elevation of the sun is sufficient to maintain this balance even at 0:00 hours; the "nightly" inversion familiar at all lower latitudes does not occur. Thus the thermal regime at the soil surface becomes in certain respects more favorable in very high latitudes, as has been found also in recent entomological studies in the arctic. Available moisture is the ultimate limiting factor, and the Dry Valleys, though free of snow for several months, are almost lifeless except locally where a little water liberated from the permafrost is drawn upward to dampen the surface. There microscopic algae and fungi develop, and provide for local populations of one or at most two species of springtails and mites—populations that may have survived in such places for long ages.

Many questions, of course, remain. More detailed studies of the bionomics of individual species are especially desirable. In the arctic, as the heat budget of the season decreases, the persisting species tend toward a life cycle extended over several years, with growth in a given season determined largely by chance. Presumably this opportunism is even more marked at the polar limit. Is some minimum of growth necessary? Or can such organisms persist under snow for a long succession of unfavorable years? The present book sets the stage, in very useful fashion, for many further discoveries.

J. A. DOWNES
Entomology Research Institute, Canada Department of Agriculture, Ottawa

Elementary Processes

High Energy Astrophysics. Vol. 2. Lectures delivered at the 1966 Summer School of Theoretical Physics, Les Houches. C. DEWITT, E. SCHATZMAN, and P. VÉRON, Eds. Gordon and Breach, New York, 1967. xii + 332 pp., illus. $12.50.

This is the middle volume in a three-volume series based on lectures given at the 1966 Les Houches summer school on the general topic of high energy astrophysics. The first volume concentrates on extragalactic radio astronomy, the third on high densities and general relativity; the middle volume deals with elementary processes and acceleration mechanisms. The Les Houches series is a more ambitious publishing enterprise than the compact book on a "rival" summer school at Varenna, on the same subject, one year earlier. A fat series of books may seem surprising at first on a "mere" borderline subject between high energy physics and astronomy. However, these books really have the flavor of a lecture course, rather than a compact résumé, and as such give some background from each of the two parent subjects as well as information on the borderline itself. To summarize this review before giving a few details: These books are not for those readers who like the maximum of new-information content per page, but for those who enjoy the charm of a live lecture course captured in print.

The largest single chunk in this volume, written by H. Y. Chiu and his collaborators, deals with "Elementary processes in astrophysics." In some

ways the most unusual part of this chapter is an unhurried and clear review (by Chiu and Zaidi) of quantum field theory, which is quite orthodox in its "bookwork" but illustrates the methods by applications to neutrino processes and other astrophysical problems (it also contains reprints of two papers on neutrino astrophysics which are a little dated by now, but still enjoyable). A chapter by H. Reeves on "High-energy nucleosynthesis" has a similar flavor, with an unhurried review of the relevant parts of nuclear reaction theory and general nucleosynthesis preceding the main topic. Twin chapters on the origin of cosmic rays, a mathematical but clear treatment by E. Schatzman and a delightful qualitative one by V. L. Ginzburg, conclude this volume.

EDWIN E. SALPETER
Laboratory of Nuclear Studies, Physics Department, Cornell University, Ithaca, New York

Some Looks at Dielectrics

Ferroelectricity. Proceedings of a symposium, Warren, Mich., Sept. 1966. EDWARD F. WELLER, Ed. Elsevier, New York, 1967. xiv + 318 pp., illus. $29.

You have heard the parable about the committee of blind men who examined an elephant to find out the nature of the beast. This book is their report; the mythical beast is called "Ferroelectricity." Fortunately, no one dares to state what ferroelectricity is; for ferroelectricity is all the various phenomena and points of view which are discussed by the authors who contributed to this excellent volume. And probably a good deal more, besides. The reference to blind men is not intended to carry the implication that any of the 21 authors exhibits any kind of blindness. On the contrary, the general excellence of the book I attribute to the choice of perceptive authors. Each has felt free, however, to examine the beast myopically and, instead of reporting encyclopedically, to do his own thing.

The book begins with three short contributions. J. C. Slater presents the anharmonic potential picture and the now standard Cochran discussion of the soft-mode theory of displacive ferroelectricity. H. Fröhlich writes about dielectric instabilities, mentioning especially the importance of electronic effects in triggering instabilities. Lars Onsager discusses some measurements and speculations about ferroelectricity in that well-known but little understood substance, ice.

Then all hell breaks loose. Joseph L. Birman gives a marvelously Birmanesque and detailed discussion of the use of group theory in the Landau theory of second-order phase transitions. He finishes with a brief review of electronic contributions to displacive transitions.

Another short contribution follows, from W. Cochran, on the lattice dynamics of several diatomic crystals with the NaCl structure, which unexpectedly exhibit soft-mode behavior, that is, possess an infrared active phonon mode with low and strongly temperature-dependent frequency.

A. A. Maradudin now does his thing. He presents a complete anharmonic theory of lattice dynamics, which aims at encompassing both ferroelectric and paraelectric phases in one crystal Hamiltonian. The Hamiltonian is used to calculate thermodynamic quantities, such as the free energy important in the Devonshire theory. A major problem is the handling of the terms in the Hamiltonian which describe unstable modes, that is, which give imaginary frequencies at low temperatures. I am unprepared to judge the success of Maradudin's venture: I marvel.

B. T. Matthias appears, to take us on an all too short tour of his world. This involves, in seven pages, a history of ferroelectricity, a catalog of mechanisms, a tour of the periodic table, and a brief look at connections between various cooperative phenomena such as ferroelectricity, ferromagnetism, and superconductivity. Wow!

Light scattering in ferroelectric crystals, a subject which has justly brought him renown, is discussed by Herman Z. Cummins. Cummins is concerned primarily with Brillouin scattering, which discloses the coupling of the acoustic phonons with polarization fluctuations near the ferroelectric transition temperature. There is a brief section on critical Rayleigh scattering, or opalescence.

By now, it is time for A. S. Barker, Jr., to present an impressive review of infrared dielectric behavior. He discusses everything of importance: the Lyddane-Sachs-Teller relation derived from Kramers-Kronig relations; local field effects, particularly in the perovskite lattice; the unfolding of infrared reflectivity data to get the dielectric function, and the complications of frequency-dependent damping. He then reviews measurements in several perovskites and hydrogen-bonded ferroelectrics.

I shall deal more briefly with the remaining papers in the volume, largely for reasons of personal interest, even though, perhaps, in doing *my* own thing, I do an injustice.

I. P. Kaminow reviews electrooptic materials and the connection between electrooptic and other phenomena such as nonlinear optics and the Raman effect.

Lithium niobate is presented by K. Nassau.

There are two papers on KNO_3, by Michel A. Nusimovici and J. G. Gay. Nusimovici discusses exhaustively the group theory of the three known phases, whereas Gay concentrates on the ferroelectric phase and discusses possible mechanisms causing a spontaneous dipole moment.

B. C. Clark, R. Herman, D. C. Gazis, and R. F. Wallis discuss size and shape effects on the stability of crystal lattices, an important problem, for example, when one wishes to study ferroelectricity in thin films.

Polycrystalline KNO_3 films are discussed by J. P. Nolta, N. W. Schubring, and R. A. Dork; film charging by dielectrics, by H. L. Stadler.

The Prague Conference on Ferroelectrics, 1966, is summarized by Joseph Lajzerowicz, and the summary of the conference from which this book sprang is presented by M. Balkanski. The final item in the book is an after-dinner speech prepared by P. Debye, on the solid state around 1910. He recalls the contributions of Planck, Einstein, and others, including himself, in those exciting and germinal years.

The book possesses an author index, and a somewhat uneven subject index, but it does not much matter. For it will not replace any of the excellent standard monographs on the subject of ferroelectricity (Fatuzzo and Merz, Jona and Shirane, and Megaw). Instead, it portrays the current (1966) thrust of research on ferroelectricity, ignoring such important achievements of the past as Devonshire's thermodynamic formulation, in favor of the current microscopic point of view. The book is important, not for its completeness, but because of its intensity.

J. M. WORLOCK
Bell Telephone Laboratories, Holmdel, New Jersey