chapter opens with a presentation of the experimental evidence, illustrated by tables and graphs; this is followed by detailed theoretical discussion, a comparison between theory and experiment, and an interpretation of the experimental results. An appendix on the statistical treatment of observations and auxiliary tables for the cascade theory computations will be useful to the research worker and student. The great compass of literature covered will make this compendium an invaluable help to anyone working in cosmic ray physics. It should be pointed out, however, that the student will have to make use of the original literature quoted, since so much is digested in the treatise that it is impossible to give detailed derivations for every formula.

It should be mentioned that, although the author addressed this book primarily to the specialist, he has followed it up with a small text for the general reader—*The frontiers of science series: cosmic rays and nuclear physics*—which will be useful to students as an introduction to the larger volume.

K. LARK-HOROVITZ

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Vacuum tube amplifiers. (Massachusetts Institute of Technology Radiation Laboratory Series.) George E. Valley, Jr., and Henry Wallman. New York-London: McGraw-Hill, 1948. Pp. xvii + 743. (Illustrated.) $10.00.

This book, the 18th volume in the Radiation Laboratory series, discusses amplifier types that are used in radar systems, but are more generally applicable to the whole field of instrumentation, control, and special communication devices. It is recommended to engineers in these fields as a valuable reference and to others as a good introduction to the subject.

The introductory chapter treats the analysis of linear circuits by operational methods. Subsequent discussions cover video amplifiers; wide band, high frequency amplifiers; low frequency, band pass amplifiers; and direct-coupled amplifiers. In each case a theoretical analysis of pertinent circuitry is supplemented by a detailed exposition of design principles. Particular attention is directed to those factors affecting gain, band width, dynamic range, and fidelity of response. Much practical design advice is included. However, in some cases practical difficulties may not be sufficiently stressed. Inveterate optimists are warned against the suggestion (p. 193) that a stagger-tuned IF strip might be realized with only inductance tables, a soldering iron, and a pair of pliers. Final chapters cover the theory of amplifier noise, minimal noise design, and the measurement of amplifier noise.

The technical level of the discussion is uniformly high. The material presented is up to date and definitive of current design practice. Some of it has heretofore been available only in periodicals or in reports having limited circulation.

Excellent editing is apparent. The 14 chapters, separately written by 10 contributing authors, maintain very satisfactory continuity. Illustrations are plentiful and references adequate. The index appears too brief, but a detailed table of contents facilitates location of material.

J. G. REID, JR.

National Bureau of Standards

The face of the moon. Ralph B. Baldwin. Chicago: Univ. Chicago Press, 1949. Pp. xiv + 239. (Illustrated.) $5.00.

Over a period of several years, Dr. Baldwin has been studying the moon's surface particularly from photographs made at the great observatories, and his conclusions have been set forth and justified in his new book. His contention is that meteorite impact is solely responsible for all lunar features except the obvious blowholes that are lined up in curving rows in many regions of the moon. Lunar lava has altered many of the features thus produced by impact, but even the great Mare Imbrium, "tolerably circular," and 700 miles in diameter, is included as an impact explosion crater.

His too-rapid dismissal of slow igneous processes, in which he largely falls into the usual error of comparing lunar formations with present-day terrestrial volcanoes, will hardly serve to convince those who continue to wonder how craters 50 or even 100 miles in diameter can be only two or three miles deep, if formed by meteoritic bombardment. He discusses this problem in a chapter on "correlations," but somehow it doesn't quite convince. The violence of an impact explosion would have been so great that large craters, whose walls would be below the horizon for an observer at the center, could hardly have been formed. On a plane surface, perhaps it would be possible, but the moon's surface is too sharply curved.

But Dr. Baldwin's book is the only modern comprehensive championing of the impact hypothesis, which was advanced casually and intuitively in the past. No one has more intimately studied the lunar surface, with a view toward demonstrating the truth of the impact hypothesis, nor, for that matter, has anyone so completely discussed the terrestrial meteorite craters. In two chapters totaling 50 pages, Dr. Baldwin has given a very valuable description and discussion of the known and suspected impact craters on our own planet. It is somewhat amazing, however, to find him quoting, with a straight face, the weird "contraterrene" hallucination of La Paz, in connection with the great 1908 Siberian meteorite fall.

Other important sections of the book are his discussions of the lunar atmosphere and hypothetical lunar history during the period outlined by the theory of tidal evolution. This latter section is a very well thought out attempt to account for the obviously different ages of the lunar features.

It is a good and valuable book, and it does not matter that it will not convert many who now believe in an igneous origin of the lunar craters. Any discussion of the moon's features by someone as thorough as Dr.

Baldwin is a welcome contribution to the somewhat neglected astronomy of the solar system.

ROY K. MARSHALL

University of North Carolina

Island life: a study of the land vertebrates of the islands of eastern Lake Michigan. (Cranbrook Institute of Science, Bull. No. 27.) Robert T. Hatt *et al.* Bloomfield Hills, Mich.: Cranbrook Institute, 1948. Pp. xi + 179. (Illustrated.) $4.00.

Insular plant and animal populations have always held a peculiar fascination for the student of natural history, partly because they provide opportunity to observe, record, and deduce without the harassment of the almost innumerable impinging factors that must be reckoned with in a comparable mainland study. Here there is land, there, water; the boundary line is sharply drawn, confining the terrestrial fauna, for the most part, within the area it circumscribes.

Island life is a progress report presenting the results of seven years' study of such an insular fauna. The study, jointly sponsored by the Cranbrook Institute of Science and the University of Michigan, covers 17 islands lying off the Lower Peninsula of Michigan. Mammals, birds, reptiles, and amphibians are considered, both as to distribution and as to habits that have effected the presence or absence of certain forms.

The study is well conceived, particularly in that it includes research into the geological and cultural history of the islands. The geological history, specifically the postglacial history, indicates that, following the recession of the glacial sheet, the water level dropped to around 200 feet below its present level. This provided land bridges between the islands and the mainland, but there seems little evidence from the faunal lists that these land bridges contributed materially to the distribution of the various vertebrates considered. In part, this may be due to the fact that the lake level subsequently rose around 300 feet, covering all the smaller islands, and the bulk of the larger ones. In any case, the authors hesitate to ascribe the present distribution of any form primarily to land bridge invasion.

The cultural history is interesting to the extent that man has superimposed certain introduced species (gray and fox squirrels, raccoon, and deer) extirpated others (elk, cougar, wolf, bear) and provided temporary haven for certain of man's common commensals (house mice, wharf rats, and English sparrows). The greatest single human influence seems to have resulted from the cutting of the original forest, opening the islands to many edge-dwellers that would not otherwise be there at all.

Just how the majority of terrestrial vertebrates reached the islands is open to speculation. Some undoubtedly came of their own volition—over the ice, through the water, or through the air. Some may have come via the land bridges. It is probable that some came in by drift, and evident that others were brought in by man.

The authors have been thorough in their consideration of the material at their disposal. However, one cannot help but feel that the summation may have been somewhat premature. Nearly every page poses questions that must go unanswered pending further investigation. It might be wished that one of the participating institutions would set up a permanent biological station on some one of the islands, and embark upon a 10- or 20-year program of study. Only thus could such phenomena as the relative paucity of species on the islands, as compared to the mainland, be explained. Even the largest island, Beaver, 58.4 square miles in area, and with nearly the same number of plant communities as the mainland, sustains less than one third the number of animal species.

As a progress report, *Island life* is excellent. It is well illustrated, the faunal lists are well annotated, and the analyses of the results to date are intriguing. As a stimulant to speculation and to further research, it is outstanding. The serious ecologist and vertebrate zoologist might ask for a more detailed record of specimens, localities of collection, and habitats, perhaps with maps. Such an expansion of the work would have made it more valuable to future field workers.

DONALD M. HATFIELD

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Studies on bats and bat parasites. Olof Ryberg. Stockholm, Sweden: Univ. Lund and Zool. Lab. Agr., Dairy, and Hort. Inst. of Alnarp. Pp. xvi + 330. (Illustrated.)

This voluminous publication is taken from a greater study of many years' duration. It is largely a biological account or natural history of Scandinavian bats, but the information is equally relevant to the study of North American or other bats. Thirteen pages and eight plates deal with bat parasites and these chiefly the ectoparasitic *Diptera* of the family Nycteribidae.

The geographical distribution of bats of the world is dealt with by families in the text and in individual maps. Detailed maps are given for north European species. It appears that there are very few records of bats' approaching the Arctic Circle. Few, if any, occur in strictly polar regions, and none apparently in the treeless tundra, where these predominately cave and arboreal mammals could hardly be expected to be found. Ryberg remarks on the difficulty of establishing the northern limit of bat distribution in Siberia because of the "inaccessibility of the Russian literature." In Iceland bats occur only as stragglers, two North American species having been taken during the second world war. Few species occur at the