

the past five years and also the perfect logical arrangement of the material by the author. The fourth part deals with cartesian products and sequences of sets and the final part considers in great detail the Borel sets and functions measurable B in their most general form.

The third chapter, which has to do with complete spaces, treats questions relative to sequences of sets, extensions of functions, projective sets, analytic sets, totally imperfect sets, etc.

The value of the present volume lies not only in its usefulness as an introduction to the fundamentals of topology but more notably in the completeness with which the topics treated have been handled. Even the latest results are to be found here in what appears to be exactly their proper setting relative to the rest of the subject, and full advantage has been taken of even the most recently developed methods in refining the treatment.

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Symbiose, Parasitisme et Évolution. By V. A. Kostitzin. (Actualités Scientifiques et Industrielles, 96.) Paris, Hermann, 1934. 40 pp.

It is only very recently that the mutual influences of various species of plants and animals have been studied mathematically. Volterra's *Théorie Mathématique de la Lutte pour la Vie* (1931) was, of course, the pioneer treatise on the subject; and, aside from sections of Lotka's *Elements of Physical Biology* (1925), further discussion has been almost completely confined to periodicals.

Kostitzin's stimulating booklet is valuable, less because of new contributions to the mathematical methods than because of his enlargement of the scope of such studies,—particularly by a new emphasis on symbiosis (including commensalism). Even here—so complicated does the mathematics become for problems closely approximating to nature—the most difficult case considered is that of two species, each divided into two age-groups, with rates of birth and death dependent both on age and on the extent of the mutual aid. Kostitzin inquires into periodic and stationary solutions of the differential equations, and into the stability of the latter type.

Equal emphasis is given to parasitism (harmful symbiosis). One section tells of the aid which mathematical analysis gave in determining how chlorogaster, a parasite of pagurians, develops in the hosts.

The treatment, in a booklet of this size, must too often be merely suggestive. Thus, we should be grateful for a thorough discussion of the remark that approximate agreement of periods usually signifies instability of a mechanical system, stability of a biological one.

A recent note by the author in the Paris *Comptes Rendus* (vol. 195, p. 1219) gives a suggestion of the wide applicability of this type of biomathematics. Therein he makes conjectures on the symbiotic periodicity of plant, animal, and inorganic matter of the earth as a whole; and on that of sediment, animal life, and H_2S in the Black Sea.

As this book shows, the way is open for a very salutary symbiosis (at the Christmas season we may prefer the term "commensalism") of mathematics and biology.

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