

The various groups of arthropods in each section are dealt with by authorities competent in their particular fields.

It is obviously impossible in a book of this size to include methods of colonization of all the economically important arthropods. The establishment of small laboratory colonies of insects such as rat fleas, *Culex pipiens* mosquitoes, bed bugs and cone nosed bugs, adequate for normal experimental procedures, is relatively simple and is included in the section on blood sucking insects. I feel, however, that some of this space could have been devoted to phlebotomine sandflies, which are difficult to colonize and which transmit human disease in many parts of the world. The colonization of body lice, biting midges, black flies, stable flies and tsetse flies is justifiably included, because of new successful techniques or because of the inherent difficulties involved. Papers in the *Bulletin of the World Health Organization* (31, 1964), on culture methods of arthropod vectors and their biological control agents, deal with colonization of some of these groups and of others not covered in the present volume.

The second section, on insects of domestic and stored products, describes methods of rearing and handling house flies, cockroaches, and beetle and moth pests of stored products. The third section is of more interest to the agricultural entomologist and deals with colonization of diverse plant feeding insects and mites such as pine beetles, pink boll worms, cabbage loopers and corn root worms, many of which cause extensive damage to crops.

Perhaps the most interesting sections are the last two, which deal with biological control in one form or another and the colonization and mass production of insect parasites, predators and pathogens such as nuclear polyhedrose viruses of lepidopterous pests. This and the mass production of screw worms, fruit flies and mosquitoes for actual or potential control by release of artificially sterilized males into natural populations have shown the feasibility of using non-chemical methods for controlling insect pests. And this, when so much is heard about actual or potential, real or fancied, hazards of insecticides, is reassuring.

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TO SPLIT OR NOT TO SPLIT

The Lichen Symbiosis

By Vernon Ahmadjian. (A Blaisdell Book in the Pure and Applied Sciences.) Pp. viii + 152. (Waltham, Mass., and London: Blaisdell Publishing Company, a Division of Ginn and Company, 1967.) \$5.75.

TO SPLIT a lichen into its two components, an alga and a fungus, and study them separately or to experiment on the complete thallus using radioactive tracers are the two main ways in which the physiology of this symbiosis may be examined. Professor Ahmadjian employs the first technique. The major part of this book gives an excellent account of his researches and those of his colleagues together with the results of earlier workers which are relevant to his approach. There are two chapters at the end of the book on the physiology of the complete plant and on lichen chemistry.

The book is beautifully produced, with a large number of photographs and drawings, although no scale is given on many of the latter. The drawings and photographs of lichen algae are undoubtedly the best published so far. The text is readable and informative, but there are a number of points which might be queried. In the first place, are heterocysts (page 22) any longer regarded as a method of vegetative multiplication of blue-green algae? Again, on page 31, the author cites the work of Kofler and Bouzon to support the statement that "the percentage spore discharge and germination among many temperate lichens are highest in early spring and fall when the most favourable climatic conditions for these processes

generally occur". As I understand it, the main aim of these workers was to refute the theory of seasonal spore discharge and to show that discharge and germination were more closely correlated with micro-climate and local climatic conditions than with time of year. (For example, in one year they found that the maximum discharge and germination of *Umbilicaria* spp. spores was in July.)

In discussing lichen algae, Professor Ahmadjian has stated more than once that *Trebouxia* spp. are rarely, if ever, found in the free living state (see, for example, page 17 of this book). On page 67 he says, however, "that they do occur in small isolated groups among other algae". If this is the case then it would have been valuable to have a cited reference or further details. In view of the author's scepticism that *Trebouxia* is ever free living, it is surprising that he quotes work (see page 44) which found that "when pigments were extracted from strains of *T. decolorans* and compared with those of a non-sensitive, non-lichenized *Trebouxia*" the pigments differed quantitatively but not qualitatively. Reference to the original paper¹ shows that the non-lichenized species is given as *Trebouxia humicola* (Naeg.) Treboux, which is correctly *Chlorococcum humicolum* (Naeg.) Raben., a common soil alga, and not a *Trebouxia* at all^{2,3}.

Except for a few criticisms of the type given above, the book is exceptionally useful; first, because it clearly describes a number of techniques for the culture and attempted resynthesis of the lichen symbiosis; second, because it poses many of the unsolved problems regarding the physiology of lichens; and last, because it contains a very comprehensive list of references. The book with its annotated bibliography gives an excellent survey of the present state of lichen physiology which will be welcomed by students and researchers alike.

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¹ De Nicola, M. G., and de Benedetto, G., *Boll. Ist. Bot. Univ. Catania*, 3, 22 (1962).

² Puzmaly, A. de, *Revue Algol.*, 1, 107 (1924).

³ Fritsch, F. E., *The Structure and Reproduction of the Algae*, 146 (Cambridge University Press, 1948).

GAMBLING MATHEMATICS

The Theory of Gambling and Statistical Logic

By Richard A. Epstein. Pp. xiii + 492. (New York: Academic Press, Inc.; London: Academic Press, Inc. (London), Ltd., 1967.) 80s.

THE stated aims of this book are "to dissipate the mystery, myths and misconceptions . . . to overcome the appeal of fallacies . . . and to emphasize the advantages of utilizing objective probability in gambling". In so far as an objective mathematical analysis of gambling games is relevant, the book goes far to achieve its aims. Nevertheless, the author's impressive display of negative expectations is hardly likely to daunt the gambler any more than a documentary on cancer cuts the sale of cigarettes. We are to envisage a race of gamblers who are entirely rational, and "who would rather lose intelligently than win ignorantly". A secondary purpose of the book is to unify and bring together material otherwise to be found only in widely scattered sources.

The title of the book is unfortunate. Only about fifty of its 400 or so pages accord with the usual meaning of the words "theory of gambling", and I must confess to being little wiser concerning "statistical logic" after reading this book than before. In fact, by far the greater part of the text consists of an encyclopaedia of gambling games with their mathematical analyses.

The contents can be divided roughly into five categories (although not followed sequentially in the layout of the work). First (second chapter), the author summarizes the necessary prerequisites in probability, statistics and games theory. Although mostly satisfactory, there are occasional lapses in the mathematical exactitude, some of