

good deal is made of the fact that general relativity overcomes the difficulty of 'action at a distance' by providing a 'field theory' of gravitation. Surely a more comprehensible, while deeper, view is that we are anyhow looking only for a mathematical description of phenomena, and that general relativity provides a better one than classical theory by simply abolishing the dualism between space-time and matter.

There are two remarkable omissions: the cosmological applications of the theory and the fundamental problem of extracting 'observable relations' from the mathematical formalism. These topics have been largely responsible for the resuscitated interest in relativity in recent years and it is surprising to find them not even mentioned as part of "the development of the basic ideas" of the theory. Actually they have been treated at length elsewhere, for example, in a fairly recent book by Tolman, but that suggests another shortcoming of the present book: it contains references for the work that is described, but none for what is omitted from its limited scope.

There are some misprints, slips, and obscurities in the algebra, but those detected by the reviewer are not vital.

The book will prove a valuable adjunct to the teaching of relativity, but, in the reviewer's opinion, it could scarcely be relied upon by itself to give a student a well-balanced grasp of the subject.

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IMMUNITY AGAINST ANIMAL PARASITES

Immunity against Animal Parasites

By Prof. James T. Culbertson. Pp. x+274. (New York: Columbia University Press; London: Oxford University Press, 1941.) 36s. 6d. net.

THIS most readable and interesting book is divided into three parts. The first discusses the general principles underlying natural resistance and acquired immunity to parasitic infections. The factors influencing natural resistance to parasitic infection are numerous and no one of them applies to all examples. The importance of the genetic constitution of the host is clearly shown in the differing racial resistance to malaria; negroes—even the very young before natural infection can confuse the issue—sometimes resist all efforts to infect them with *P. vivax*, whereas white persons are uniformly susceptible. Age also plays its part in resistance, and a complete chapter is devoted to the discussion of the various ways in which age influences immunity to parasites. Sex appears relatively unimportant although resistance to a few diseases is apparently influenced by this factor. Intercurrent infections usually result in depression of resistance but in some instances resistance to one parasite may be increased by simultaneous infection by another, as is demonstrated by the diminished pathogenicity of certain trypanosomes in mice infected with spirochaetes compared to the same trypanosomal infection alone, and by the behaviour of different species of malarial parasites simultaneously infecting man. The character of the diet also influences profoundly certain parasitic infections; and although the most conspicuous effects are seen upon parasites residing in the alimentary canal, yet there is evidence of dietary influences on some somatic infections. The various organs and tissues also play

their own special part in resistance to parasitic infection; the action of the reticulo-endothelial system is well recognized, but the effect of special defensive factors associated with other cells of the host and the influence of various invasive factors of the parasites themselves are not so commonly taken into account.

Turning to acquired immunity, the reader will find that therapeutic application has not perhaps made the progress that might have been hoped. This may well be because of the inherent complexity of the antigenic factors concerned, while an obvious teleological explanation is that the parasites so largely depend upon a tolerant balance between themselves and host. Nevertheless, a considerable amount of knowledge on the principles and mechanism of acquired immunity to parasites has accumulated since the first clear demonstration of such immunity almost fifty years ago, when Theobald Smith and Kilbourne showed that recovery from one attack of Texas fever protected cattle against subsequent attacks, and many aspects of parasitic immunity have been investigated, some with notable success. Pre-munition, local immunity and the influence of various mechanisms including skin response, agglutination and precipitin reactions, and the adhesion phenomenon are all discussed.

In the second section the various parasites are discussed separately and the specific immunological reactions associated with infection by them are described in detail. This section concludes with an interesting chapter on responses to arthropods, not only to bites and stings but also to somatic infection with such of them as infect the tissues.

The third part, which although short is not the least valuable, is devoted to applied immunology, and besides dealing with the practical diagnosis of parasitic infection by immunological means and the attempts that have been made to protect against such infection, gives an interesting chapter on the classification of parasites on immunological grounds.

It is clear that the chief developments have been in the field of the diagnostic tests for the various parasitic infections of man and domesticated animals, and in some diseases, particularly the somatic helminthiases, eminent success has been attained. These tests employ chiefly the detection of antibody in the tissues or blood, and so far comparatively little practical use has been made of tests for antigen, a matter for some regret since such tests would have the advantage of detecting infection in its earlier stages. Somewhat disappointing practical results have attended attempts to produce successful vaccines against parasitic infections and it appears extraordinarily difficult to reduce the virulence of an animal parasite while at the same time preserving its natural antigenic qualities. Nevertheless, as complete information becomes available, it appears more and more probable that no fundamental differences exist in the character of the immune responses to the parasites and to other agencies of disease.

Prof. Culbertson, as he himself states, has taken Taliaferro's classical monograph as his point of departure and he has worthily upheld the high tradition of the American school in this field of study. Not only has he most adequately sifted and summarized modern work, but also his text is most clearly annotated with references to original papers, and the book is therefore a very valuable review which should be in the hands of all interested in the subject.

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