the following headings: Physico-Chemical Properties, Purification Methods, Antibodies and Normal Globulins, Alteration of Antibodies, Plurality of Antibodies in Sera, Formation of Antibodies and the Theories of Antibody Formation.

Chapter 5 is devoted to a discussion of artificial conjugated antigens and serological reactions with simple chemical compounds. Most of the old material has been rewritten and much new material added. He calls attention to the observations of Haurowitz that strongly basic groups may be as effective as acid groups in directing specificity. The author has introduced new material under two new headings, one entitled "Carbohydrate-Azoproteins," and a second entitled "Pharmacologically Active Substances, Hormones." In connection with this the author discusses the attempts and failures to produce antibodies to strychnine and the success achieved in producing antibodies to thyroxine.

The title for Chapter 6 has been changed from "Chemical Investigations in Specific Cell Substances; Carbohydrates, Lipoids" to "Chemical Investigations on Non-Protein Cell Substances." In the revised edition one topic heading entitled "Serum Reactions with Phosphates and Sterols" has been deleted and four new topics added. These latter deal with "Complex Bacterial Antigens," "A Polypeptide-Like Haptene," "Preparation of Artificial Antigens Using Bacterial Proteins" and "Blood Group Substances," respectively. A few of the important things discussed by the author under these new headings are many recent findings relative to antigenic substances in both Gram-negative and Gram-positive bacteria; the polypeptide-like substance from *B. anthracis;* the new antigen prepared by combining the typhoid protein with the Shiga polysaccharide; and the precipitation of the blood group substance by antisera specific for the polysaccharides of Pneumococcus XIV.

Chapter 7 is entitled "Antigen-Antibody Reactions." In this new chapter the author discusses toxin neutralization, various aspects of the precipitin reaction, the mode of combination of antigen with antibody and serological specificity. In regard to agglutination and precipitation, the author concludes that it may be that both specific and non-specific forces may operate in the second stage of the reactions. As to the mode of combination of antigens with antibodies, he says that while there is data that warrants the correlation of serological specificity and chemical structure, yet "no finished theory of antibody reactions has yet been attained that is comparable to those that cover and make it possible to formulate the reactions of organic chemistry." While he frankly states that the present nature of the forces involved in serum reactions is still open to discussion, he says that "it is supposed that the union between antigen and antibody is brought about chiefly through electrically charged acid or basic groups, van der Waals forces and interaction between polar groups (or polar groups and ions) in which as Pauling emphasizes, hydrogen binding presumably plays an important part."

The final chapter of the book is contributed by Pauling and is entitled "Molecular Structure and Intermolecular Forces." Early in the chapter the author states that "it is, indeed, probable that the high specificity which often characterizes physiological activity is in most cases specificity of intermolecular interaction rather than primarily of chemical reaction with the rupture and formation of strong bonds." He discusses the structure of molecules, electronic van der Waals attraction, hydrogen bonds, and the interaction of electrically charged groups in proteins and their relation to serological reactions. It is a well-written chapter and throws light upon many statements made in the preceding chapters.

The reviewer feels that the book is well written and is indeed a classic in the field of immunology. It should be regarded as a "must" book for all who are both interested in the subject and who possess an adequate scientific background.

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THE ALGAE

Structure and Reproduction of the Algae. By FELIX E. FRITSCH. Vol. 2 (Phaeophyceae, Rhodophyceae, Myxophyceae). xiv + 939 pp. Frontispiece. 336 text figs. 2 maps. Cambridge: University Press. 1945.

PROFESSOR FRITSCH has undertaken the immense task of bringing together all that is known of the morphology and reproduction of the great plant group of Algae. Modern developments in this field are so extensive that it probably will not be possible for one man to accomplish this again. Only once before has it been successfully attempted, when Oltmanns[1] brought together a summary of all that was known about algae except their detailed taxonomy. Fritsch's two volumes are alike in treatment and constitute an advanced reference work. The amount of material reviewed is huge, and documented in detail; it is clear that every effort was made to include all significant work. After a Foreword the author analyzes the three great groups not covered in the first volume. These are dealt with in the same meticulous fashion which characterized the treatment of the Chlorophyceae and other groups covered earlier.[2] For each of the three classes there are several pages of general

[1] "Morphologie u. Biologie d. Algen," 1904–05, edit. 2, 1922–23.
[2] Vol. 1, 1935; SCIENCE, 83: p. 437, 1936.

information regarding cell structure, vegetative organization, food reserves and reproduction, followed by detailed descriptions of the special morphology and reproduction of each family.

It evidently was not the author's object to stress more than morphology and reproduction; taxonomy appears only so far as is necessary to give orderly presentation, and ecology, physiology and utilization are but incidentally involved. Fritsch has managed very well to bring together the immense new literature, avoiding that which is unsound or superficial, while retaining that part of the old material which has never been superseded.

The Foreword presents a brief introduction to seaweeds through their ecology and distribution. The ranges offered for some of the examples selected seem misleading; for instance, on the maps the southern boundary for the Agareae on the American coast is set on Labrador, though these plants are well known to occur in northern Massachusetts, and for the Laminariales in general it is set on Nova Scotia, though these plants are common off southern Masachusetts. The folding maps are inconvenient; if the data had been divided and small maps used as text figures they would have been more effective.

The morphology and reproduction of the Phaeophyceae are treated for each group in order, with a section summarizing our knowledge of the life histories. The works of Sauvageau, Svedelius and Kylin have contributed most to the expansion of the account over earlier compilations. The author naturally develops the discussion in line with his views on the primitive heterostichous state of these plants, a conception which he has enlarged upon in several recent papers. He stresses the importance of vegetative structure rather than the degree of reproductive differentiation. This produces a change in the sequence of treatment of the Orders, and causes the merging of Punctariales and Dictyosiphonales as climax families in the ectocarpalean series. Emphasizing the type of growing point he associates the Sphacelariales, Dictyotales and Fucales with increasing departure from the single apical growth initial.

The Rhodophyceae are divided in the usual fashion into Bangioideae and Florideae. In the first subclass the Porphyridiaceae is accepted, and enlarged to include such filamentous genera as *Asterocytis* and *Goniotrichum*. The Florideae are considered first from the general morphological standpoint, which calls for an immense amount of detail. The heterostichous habit is again a basis for interpretation and is only considered lacking in the Ceramiales. There are sections on symbiosis, special cell contents and such features. Reproduction is then discussed in another review of the families, using a relatively few types thoroughly analyzed in each. A large proportion of this material is recent, based on the work of Svedelius, Kylin and other contemporaries; in general the classification developed by Kylin is followed.

The Myxophyceae are largely covered in general sections, as the low degree of plant organization does not require a detailed systematic approach. Perhaps because of this, this section, thorough though it is, seems rather more attractive to a general botanical reader than the very detailed treatment of the Rhodophyceae.

The two volumes of this work by Fritsch are of about equal thickness, because of slightly thinner paper and boards used for the second, though it is about 150 pages longer. The cloth, boards and binding seem too light for a work of this bulk and potential length of service. The quality of the paper is commendable under war-time circumstances, though its uneven color betrays the difficulties under which it was produced. The 336 groups of pictures give a wealth of illustration greater than has been attempted in a work of this kind; most of them have not been used before in a text-book, and have been taken from the most recent research publications. Reproduction of the drawings is very good, and the halftone cuts were evidently most carefully prepared by the engraver, though the character of the paper has prevented the end results from being as good as in the first volume.

In summary, we have now for the first time in English a comprehensive account of algal morphology, including reproduction, adequately related to physiology, ecology and presumed evolutionary trends, in an excellent and convenient form. Its completion represents a very great accomplishment, and the long period through which it will remain a standard reference justifies the labor spent upon it.

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