

tions of applied science, is, I am sure, very largely due to the success of Sigma Xi.

Sigma Xi stands "for intellectual energy rather than sordid ambition," and the volume so ably compiled by Professor Ward richly demonstrates the fact that it "has become a prominent factor in most of our universities." In the words of one of its founders in consequence of its influence:

Men have come to know that knowledge of the present is far more important than tradition—that individual discernment, power of initiative, and honesty, surpass all authority in the equipment of a scholar of the new sort.

MARCUS BENJAMIN

An Introduction to the Chemistry of Plant Products. By PAUL HAAS and T. G. HILL. Published by Longmans, Green and Co., London, New York, Bombay and Calcutta. 1913. Pp. xii + 401.

The progress of chemistry, perhaps more than of any other science, may be divided into great epochs, in each of which one branch of the science is found to be far more productive of permanent results than are the other divisions.

The centuries-long period of alchemy gradually merged into the period when chemical researches were conducted with the view of enlarging the number of compounds which could be utilized in medicine.

Following the discovery of the nature of combustion, we begin to find the first organized chemical research, devoted in the main to inorganic chemistry, which rewarded us with a gradually increasing number of elements, with the atomic hypothesis, and the gas laws.

Thus until 1828 nearly all of the chemical investigations were confined to inorganic chemistry, for the compounds of carbon were supposed to be formed only by the action of life. When, however, Wöhler made his famous synthesis of urea, a new field was opened and the immense number of organic compounds listed in "Beilstein" are in a large measure the result of the studies of the period of organic chemistry.

For a time organic chemistry overshadowed

inorganic chemistry until, under the leadership of men like Arrhenius, Ostwald, Nernst and Van't Hoff, a new chemistry was created which we know as physical chemistry. And even in our own time we have seen the science of radioactivity follow the discovery of radium by Mme. Curie.

During all of these advances the chemistry of the life processes has been more or less neglected. To be sure, a great many of our universities list courses in "physiological chemistry," but until very recently these have been devoted almost entirely to the study of nutrition and the chemistry of pathology, and even to-day the study of the chemistry of the life processes is only at a beginning. This is perhaps necessary, for it would be a useless task to undertake to determine and measure the life processes without the exact knowledge furnished by the organic and physical chemists.

We are thus, probably, near the beginning of a period of biological chemistry, not only the chemistry of animal life, but the chemistry of plant processes as well, not only from the standpoint of the physician and utilitarian; but from the broader standpoint of the study of life itself, its chemical products and the laws by which it is governed.

We have many admirable text-books dealing with physiological chemistry, but text-books which are suitable for a course in plant chemistry are rare. This may perhaps in part explain the absence of such courses from the curricula of our universities. It is, therefore, a pleasure to find such a book as "An Introduction to the Chemistry of Plant Products."

Modeled somewhat after Hoppe-Seiler's "Handbuch der physiologisch- und pathologisch-chemischen Analyse," but dealing only with plant products, there is a wealth of information in the 400 pages. Each group of plant constituents is discussed, first under the general group, then under the group subdivisions, and lastly each compound is given, its structural formula (when known), its properties, its chemical reactions, its micro-chemical reactions in many cases, the qualitative tests

for its presence, and the methods for its quantitative estimation. The quantitative estimation is illustrated in a majority of the cases by an example, so that the student can not go astray. Perhaps in some of these cases the calculations could have been omitted, for many are so simple that any one who could understand the directions should be able to calculate percentage, etc., but it is better to err in being too explicit rather than be too obtuse.

The literature has been well reviewed, but, unfortunately, the book contains no author index, so that the numerous author citations lose a very considerable part of their value. It is to be hoped that this feature will be remedied in a second edition.

The book is well printed on good paper, and is remarkably free from typographical errors. It should prove a useful volume to the average chemist, and invaluable to the plant physiologist or the teacher of plant chemistry, both as a reference book and as a text-book. Needless to add it should be in every chemical library.

ROSS AIKEN GORTNER

SPECIAL ARTICLES

THE ORGANIZATION OF THE CELL WITH RESPECT TO PERMEABILITY

IN studies on permeability it is assumed that we need consider but one surface, namely, the outer "plasma membrane." It seems desirable to emphasize that the problem really involves a variety of surfaces¹ the permeability of which may be decidedly different.

Good illustrations of this may be found in many kinds of plant cells. A very favorable object for investigation is afforded by the marine alga *Griffithsia*. Within the cell wall is a thin layer of protoplasm which surrounds a large central vacuole. The protoplasm therefore forms a sack which is filled with liquid. It is capable of expanding or contracting as water is taken up or withdrawn by osmotic exchange.

¹The term surface is preferred, since a semi-permeable surface may exist where there is no definite membrane.

If these cells be placed in hypertonic sea water water is withdrawn from the cells and the protoplasmic sack contracts: on replacing the cells in sea water the sack expands to its original size. If in place of hypertonic sea water we use hypertonic NH_4Cl the sack likewise contracts, but the inner wall of the sack contracts a great deal more than its outer wall. The space between the two surfaces which is normally very small may increase until in places it equals one third of the length of the cell.

There are, therefore, two surfaces, the outer surface of the protoplasm ("plasma membrane") and the inner surface (vacuole wall) which do not act alike with respect to permeability. The interpretation of their behavior may be twofold. In the first place, the outer surface may be regarded as more permeable to NH_4Cl than the inner. The salt would therefore cause the outer surface to contract less than the inner since it is well known that the more freely a substance penetrates the less is its plasmolyzing power.

On the other hand, we may have to do with an alteration of permeability produced by the NH_4Cl . If the NH_4Cl produces an increase of permeability it may cause a contraction by what has been called false plasmolysis.² If the false plasmolysis of the inner surface is greater than that of the outer the effect which we have witnessed may result.

It is of course quite possible that both of these interpretations are correct and that we have both true and false plasmolysis contributing to the result. The writer is inclined to think that this is the case.

By lowering the concentration of the NH_4Cl we can produce a marked contraction of the inner surface while the outer still retains its full turgidity and shows no sign of contraction. This is most strikingly shown where a living cell adjoins a dead one. The turgidity of the living cell causes its end wall to bulge into the dead cell. As soon as the living cell loses its turgidity the end wall ceases to bulge and becomes nearly flat. It is therefore easy to determine whether the cell is turgid or not.

²Cf. *Bot. Gazette*, 46: 53, 1908; 55: 446, 1913.