Here in their mother's heart the young marsupials are nourished for some time, when they are expelled from the mother fully developed and ready to begin life."

C. C. Nutting

SCIENTIFIC BOOKS

Infection and Resistance. By Professor Hans Zinsser, Professor of Bacteriology at the College of Physicians and Surgeons, Columbia University, New York City. The Macmillan Company. 1914. Pp. 546. Illustrated. $3.50.

This work is conspicuously the most thorough and modern original treatment of the subject of infection and immunity that we have in the English language. The author's own work in the field of immunology, citations to which are frequently made in the text, makes the book authoritative.

We find in the book an exhaustive and impartial analysis of the enormous accumulation of recent work in this field with a wealth of references to original sources given at the bottom of the pages. The survey of the subject is complete, and yet each chapter is a unit in itself, making the book a convenient reference in which to gain a knowledge of any one phase of immunity. This unit arrangement of the chapters has necessitated some repetition, but not to an extent to become boresome.

The text is not intended to be elementary or summary and can not be recommended for the average reader or undergraduate student. It can be most cordially recommended to practitioners, teachers, laboratory workers and especially as a text for medical students for whom it is primarily intended.

Starting with the general problem of Virulence, the author discusses successively the Bacterial Poisons, Natural and Acquired Immunity, Antitoxins, Cytolysis, Complement and Diagnosis, Agglutination, Precipitation, Phagocytosis (four chapters), Anaphylaxis (three chapters), Therapeutic Immunization, and a chapter on Abderhalden's Work on Protective Ferments. Dr. Stewart W. Young has been invited to write a concluding chapter on Colloids, which gives a comprehensive idea of the nature of this state of matter, and the relation of colloids to biological problems.

The chapter on Therapeutic Immunization in Man might be criticized on account of its brevity in contrast to the rest of the book. It seems to the reviewer as though it could be made more effective even in the space allotted by the introduction of more data to show the efficacy of our marvelous advances in immunology.

C. M. Hilliard

The Differentiation and Specificity of Starches in relation to Genera, Species, etc. Stereochemistry applied to Protoplasmic Processes and Products, and as a Strictly Scientific Basis for the Classification of Plants and Animals. By Edward Tyson Reichert, M.D., Professor of Physiology in the University of Pennsylvania, Research Associate of the Carnegie Institution of Washington. In two parts. Published by the Carnegie Institution of Washington, Washington, D. C. 1913. Pp. 900, plates 102.

The author intends that the present memoir on starches shall have a relation to the memoir on hemoglobins worked out by Reichert and Brown and reviewed in Science (January 27, 1911). If there is a relationship between these two memoirs it is rather in what Dr. Reichert has attempted to perform than in what he has succeeded in accomplishing. The two memoirs are so different that a comparison of them is well-nigh impossible. In the one, we almost see the master and in the other the novice. The memoir on hemoglobins represents a painstaking research and is an important contribution to biology. The memoir on starches, in its present form, is hardly worthy to be classed as research, particularly in view of the splendid monograph of Naegeli which has been reputed to be among the greatest investigations of the last century. In the work on hemoglobins, through the cooperation of Dr. Brown, the exact methods of physical crystallography have been employed and it is to be expected that in the hands of different investigators confirmatory results will be obtained in the examination of the crystals of the various hemoglobins. In the present memoir on

starches, Dr. Reichert has replaced exact quantitative methods by those which under certain conditions might have a confirmatory value, but certainly are of no specific importance, as will be shown later, so that independent investigators may be able to confirm his observations and distinguish one species or genera from another. It is only necessary to read carefully a work like that of Solereder on the "Systematic Anatomy of the Dicotyledons" to appreciate the nature of the task that confronts an investigator who attempts to solve a fundamental problem such as Dr. Reichert has attempted.

Before critically examining the work it may be desirable to mention the contents of these two large volumes. Nearly 300 pages are devoted to a résumé of the important monographs and some of the important papers on the starches. The best part of this portion of the work is the translation from Naegeli's monograph on "Die Stärkekörner," giving his classification of some 1,200 starches. This comprises nearly 100 pages. Any review of the literature on starch must be unsatisfactory, as it is likely to be inadequate, and this is especially true of the summary by Dr. Reichert. It would have been far better in a memoir like this had Dr. Reichert placed in chronological order the literature which he cited so that it might be consulted or referred to by the student and the investigator, particularly if he intended this to be a work of reference on starches.

In Chapter VI. we find a discussion of some of the methods that the author considers might be employed in an investigation of this character and which involved the study of over 300 starches, which he isolated from as many different plants. He employed essentially six different methods: (1) Histological method, involving the study of the form, markings and size of grains. (2) Polariscopic properties, *i. e.*, reactions using polarized light both with and without selenite. (3) Iodine reaction, using 0.125 per cent. and 0.25 per cent. of Lugol's solution. (4) Action with aniline dyes, using gentian violet and safranin, using 5 c.c. of a solution containing 0.05 per cent. of aniline dye. (5) Temperature of gelatinization, which was determined with a specially constructed water bath, and in which was placed test tubes containing a small quantity of starch with 10 c.c. of water. (6) Several swelling reagents were used, viz., chloral-hydrate-iodine solution, chromic acid in the form of a 25-per-cent. solution; ferric-chloride solution consisting of equal parts of a saturated solution in water, and Purdy's solution, which was made up of equal parts of the standard solution and water.

In the preparation of the starches, the material was comminuted, mixed with water, strained through cheese cloth, centrifugalized and washed with water and re-centrifugalized to remove as much impurity as possible.

The various starches were photographed both with and without polarized light. Some of these photographs are very excellent and in some instances may be of some scientific value. For the most part, however, unless photographs of starches are supplemented with drawings they lose much of their interest and significance.

Great stress is laid by the author on the different reaction intensities of the several reagents on any given starch and these have been set forth graphically in the form of curves with a view of affording a clear presentation of the quantitative reaction peculiarities of the starches and permit of comparison between them. "In the construction of the charts the abscissas have been used to express the degree of polarization (*P*), the intensity of the iodine reaction (*I*), the intensity of the gentian violet reaction (*GV*), the intensity of the safranin reaction (*S*), the temperature of gelatinization (*T*), the time-reaction of chloral hydrate-iodine (*CHI*), the time-reaction of chromic acid (*CA*), the time-reaction of pyrogallic acid (*PA*), the time-reaction of ferric chloride (*FC*), and the time-reaction of Purdy's solution (*PS*). The letter or letters as above given in parentheses each lie at the head of a special column or ordinate, and indicate the agent, while those of the abscissas give the values of the reactions. The letters of the column under *P* indicate, respectively, very

high, high, fair, low and very low; and under *I, GV* and *S,* very dark, dark, fair, light and very light."

The procedure in the examination of the several starches by Dr. Reichert is as follows: The temperature of gelatinization and intensity of color of aniline dyes was determined by placing *a small amount of starch* in a test tube containing in the one case 10 c.c. or an excess of water and in the other case 5 c.c. or an excess of solution of the dye. In using iodine solution he does not say how much starch was employed, but merely states that "the starch was placed on a slide and one or two or more drops of the iodine solution added, the whole covered with a cover slip." In the use of swelling reagents we read that "a small amount of starch is placed on a slide, several drops of the reagent added, a cover glass put on, and the progress of events examined under the microscope." Granting that there is a certain variation to a limited extent in the shade and intensity of color produced by certain reagents with some of the starches,[1] these differences will only hold when definite quantities of starch and definite quantities of reagent are used. From the statements in the foregoing paragraph showing the method of making microscopic mounts, it is apparent that Dr. Reichert did not bear in mind this fundamental fact as he did not use definite quantities of starch with definite quantities of reagent. One illustration is sufficient to show the weakness of his technique and the untrustworthiness of his results. Let the worker make four mounts, using varying quantities of starch and iodine solutions as follows: (1) 0.003 gm. of starch and 1 drop of iodine solution; (2) 0.006 gm. of starch and 1 drop of iodine solution; (3) 0.003 gm. of starch and 2 drops of iodine solution; (4) 0.006 gm. of starch and 2 drops of iodine solution. If a solution be employed containing 0.25 per cent. of Lugol's solution as adopted by Dr. Reichert, the intensity of color will not be as pronounced as if a reagent containing 0.50 per cent. of Lugol's solution be used. In any case the reactions in the several mounts will show considerable variation, a more intense blue coloration being usually discernible in mounts containing 0.003 gm. of starch and 2 drops of reagent and weakest in mounts containing 0.006 gm. of starch and 1 drop of reagent. Nearly equally as striking differences will be obtained when using varying quantities of starch with two or more drops of the swelling reagents employed by Dr. Reichert. A more noticeable and complete swelling being produced when less starch (0.006 gm.) is employed, with an excess of reagent (4 drops), and a partial or incomplete gelatinization always being observable when an excess of starch (0.012 gm.) are used with a minimum quantity (2 drops) of the swelling agent. When we consider the nature of starch these varying results are to be expected unless a quantitative relation be borne in mind between the amount of starch and the number of drops of reagent employed.

The method employed by Dr. Reichert in determining the temperature of gelatinization and of coloration with aniline dyes might have been applied to the use of other reagents. In the designation of intensity of color reaction with aniline dyes and iodine, Dr. Reichert was unfortunate in adopting an arbitrary scale of very dark, dark, fair, light and very light, as hardly any two observers would agree as to whether a color was dark or fair, etc. It would have been a great deal better had there been an accurate color scale embodied in the publication so that Dr. Reichert's work could be confirmed.

In view of these serious criticisms involving a crude technique and one which is liable to give discordant results in the hands of different investigators we must conclude that Reichert's work has added practically nothing to the interesting question of stereoisomerism of the starches, nor can it be considered as a serious contribution to our knowledge of the specificity of starches in relation to genera, species, etc. Apparently it will be very difficult for any one very soon to add anything of a fundamental character or in a comprehensive way to the study of starches and that can be at all compared to the monumental work on "Die

[1] *Bot. Gaz.,* October, 1905.

Stärkekörner" written by Naegeli in 1874. This does not mean that there are not many interesting and important problems connected with the study of the starch grain, but the solution of these can be accomplished only at the hands of the experienced specialist engaged in research or under the direction of a master mind.

HENRY KRAEMER
PHILADELPHIA COLLEGE OF PHARMACY,
March 27, 1915

SPECIAL ARTICLES

THE OSMOTIC PROPERTIES OF DIFFERENT KINDS OF MUSCLE

IN two recent articles[1] I have pointed out that the osmotic properties[2] of the smooth and striated muscle of the frog and of the clam's adductor muscle were strikingly different. Loeb suggests[3] that the differences observed by me might be due to the fact that "the smooth muscle of the stomach . . . can not be obtained in as natural a condition as . . . striped muscle . . . ." Still more recently, in an article published from Loeb's laboratory, v. Körösy[4] has enlarged upon Loeb's suggestion and has described some experiments purporting to uphold it.

The reasons for thinking that the differences in the osmotic behavior of the three types of muscle mentioned above can not be due to any difference in the manner of their preparation seem to me very cogent; they have already been largely given in my articles dealing with the subject. But it has not previously been possible to give them completely or to bring them together into one place, and, in view of the suggestions of Loeb and v. Körösy, it seems worth while to do this now.

The first difficulty which one meets in comparing the reactions of smooth and striated muscle is that cutting across the fibers or removing the "natural surface" does not have the same effect on the two tissues. Striated muscle goes almost immediately into rigor in the neighborhood of a cut across its fibers. This condition is accompanied by acid formation,[5] by swelling, and by the loss of irritability and of the characteristic osmotic properties of the tissue; it spreads gradually from the point of injury to other parts. Cutting across the fibers of smooth muscle causes a contraction which is soon followed by relaxation; there is no tendency toward acid formation, swelling or loss of irritability either in the neighborhood of the cut or in any other portion of the tissue. These facts, which are ignored by Loeb and v. Körösy, are very significant; they suggest at the outset, what is confirmed by all my subsequent work, that the fibers of striated muscle are surrounded by characteristic semi-permeable surfaces, injury to which produces profound changes in the tissue; and that no such surfaces exist in the case of smooth muscle. They are incompatible with the view that the osmotic properties of the tissues are alike. Finally, they show that my preparations of smooth muscle, in spite of the fact that their fibers have been cut, are more nearly comparable to uninjured than to injured preparations of striated muscle.

But one need not stop here. The rigor, etc., produced in the neighborhood of a cut across the fibers of striated muscle spreads only gradually from the injured to the uninjured regions; hence, if the injured area be proportionally small, the preparation will react osmotically for the first hour or so very nearly like an uninjured muscle. If a frog's sartorius be cut across its middle, either half of the muscle will have about the same proportions of "natural surface" and "unnatural surface" as the preparations of frog's stomach muscle used in my experiments. Such a cut sartorius reacts for the first hour in all respects very much like an uninjured sartorius. The strikingly different osmotic reactions characteristic of smooth muscle showed themselves

[1] Meigs, *The Journal of Experimental Zoology*, Vol. 13, p. 497, 1913; *The Journal of Biological Chemistry*, Vol. 17, p. 81, 1914.

[2] By "osmotic properties" I mean those properties of the tissues which determine the characteristic changes of weight undergone by them when immersed in various solutions.

[3] Loeb, SCIENCE, N. S., Vol. 37, p. 430, 1913.

[4] V. Körösy, *Zeitschrift für physiologische Chemie*, Vol. 93, pp. 171 *et seq.*, 1914.

[5] Fletcher and Hopkins, *The Journal of Physiology*, Vol. 35, pp. 261 *et seq.*, 1907.