restrial causes will always remain, and the eclipse plates, whatever their results, can not be cited as proof of the Einstein theory.

CHAS. LANE POOR

DECEMBER, 1922

CHANGE OF FREQUENCY ON SCATTERING

A. H. COMPTON in a lately received bulletin of the National Research Council has reported some recent results obtained by him showing an increase in wave length of X-rays on scattering by graphite of the Molybdenum Kα line amounting to .022Å. U. A. Sommerfeld in his recent lectures, and Compton in *Phys. Rev.*, February, 1923, page 207, have shown that from the quantum theory the shift should be independent of the wave length of the primary beam and of magnitude $\Delta\lambda = \frac{2h}{mc} \sin^2 \frac{\theta}{2}$ where θ is the angle between the incident and scattered beam, h is Planck's constant, m the mass of an electron and c the velocity of light. At $\theta = 90°$ the value of $\Delta\lambda$ is .0242 Å.U $= \frac{h}{mc}$.

Compton states that according to his "absorption measurements, over the range of primary rays from .7 to .025 Å.U. the wave length of the secondary X-rays at 90° with the incident beam is roughly .03 Å.U. greater than that of the primary beam which excites it."

Such a shift, if it exists in visible light, should be detectable by interference methods. The writer has looked for such a shift with negative results. A Lummer-Gehrcke plate of resolving power 360,000 was used and the scattered beam compared with the direct beam using the green mercury line as well as various helium lines. The scattering substance was a block of paraffin and scattering was observed at nearly 180°, so that the shift should have been about .048 Å.U., while the plate should resolve to .015 Å.

Multiple reflections to the number of 16 at nearly 180° between silvered glass surfaces were also tried. All results were negative.

P. A. Ross

STANFORD UNIVERSITY

WHAT IS A PLANT?

THE discussions which have appeared in SCIENCE during the past weeks indicate that botanists are unable to agree as to a definition for a plant. In such a situation a chemist may perhaps be pardoned for offering a suggestion. The presence or absence of chlorophyll is obviously no criterion, for certain plants, *e.g.*, the "Indian pipe," *Monotropa uniflora,* are devoid of pigments. There is, however, one essential *chemical* difference between plants and animals. In *animals* the principal structural material is *protein* or some form of protein, whereas in plants *carbohydrates* predominate. Could not one, therefore, define a plant as "*a living organism whose cell walls consist predominately of carbohydrate materials?*" This would include the bacteria whose cell walls are composed of chitin, a nitrogenous carbohydrate. The fact that chitin forms the shell structure of certain invertebrates, such as the lobster, does not invalidate the definition, for the cell walls of such animals are composed predominately of protein.

R. A. GORTNER

UNIVERSITY OF MINNESOTA

SCIENTIFIC BOOKS

The Anatomy and Physiology of Capillaries, The Silliman Lectures for 1922 at Yale University, by AUGUST KROGH, Ph.D., LL.D., Professor of Zoo-Physiology, Copenhagen University. Yale University Press, 1922.

IN the circulation of the blood "the organs of propulsion, distribution and carrying back are all subservient to the function of exchange carried out in the capillaries and though, of course, each of the great organs is absolutely necessary for the functioning of the whole, it will be difficult to challenge the proposition that the capillaries constitute the most essential part of the whole circulatory system." Thus Professor Krogh early in the first lecture of this series emphasizes the broad importance of his topic. It is a conception which looks upon the particular topic, not as an isolated phenomenon, not merely as a "fragment of an animal," but in its bearing and function in the economy of the whole organism. This standpoint is noteworthy for its similarity to that adopted in two other masterpieces of physiological literature contributed by two previous Silliman lecturers. Krogh, like Sherrington in the "Integrative action of the nervous system" and Hal-

dane in "Respiration," recognizes that correlation and regulation are the prime problems of physiology.

The investigations by the author and his pupils, which form the larger part of the subject matter of this book, arose from the problem of the mechanism by which the exchange of substances and especially oxygen is effected between the blood and tissue elements. How is this function regulated, and adapted to the ever-changing needs and coordinated with the multifarious activities of the living body? The answer, which is one of the most beautiful of recent discoveries, is that in such a tissue as muscle there are many times as many capillaries as are ever opened simultaneously to the blood flow during rest; and that now one, now another channel is opened for short periods, to close again as yet others open. This alternation of dilatation and constriction is under a control which is largely local and is clearly dependent upon the needs of the immediately surrounding tissue elements. Only with the passage from rest to the activity of muscular work are all, or nearly all, of the capillary channels dilated. The surface for diffusion of oxygen and other nutriment is thus varied and adapted to the needs of the working muscle fibers. Spreading along and around the capillaries are the contractile elements which Krogh, in generous recognition of the investigator who first saw them, terms Rouget cells.

From the investigations of Krogh and his pupils and the work of others, which is fully reviewed, it is shown that the capillaries are contracted and dilated independently of the arterioles, and thus form a mechanism independent, in large part at least, from the vasomotor mechanism of Claude Bernard and Ludwig. Beside the heart and the vasomotor (arteriomotor) mechanism we must recognize a third and no less important factor in the circulation, consisting of the capillariomotor mechanism: a conception which the reviewer urged as necessary years ago (on much less conclusive evidence however) and called the "venopressor" mechanism, but which was then too unorthodox for some authorities.

Many suggestive observations are here reported also on the reactions of capillaries to stimuli on their part in herpes zoster and erythema, and on their behavior under the influence of heat and cold and in reaction to chemical substances, and especially to histamine.

These investigations do not yet solve the problem of functional hyperemia—the cause and mechanism of the dilatation of all the capillaries of a muscle, for instance, when it is working. But they formulate clearly the problem and take a first step towards its solution; for the discovery is reported and established of a special hormone, identical apparently with that in pituitary extract, which exerts, above every other substance tested, a capillary dilating power.

Two lectures are devoted to the topic of the exchange of substances through the capillary wall—a topic of fundamental importance, upon which many keenly conceived and beautifully executed observations are described, together with stimulating new conceptions of the process of intravital diffusion.

In the last lecture the parts played by capillaries in various processes in health and disease are discussed. The topics include the absorption of dissolved substances from the small intestine, the regulation of the aqueous humor of the eye, inflammation—that supreme problem of pathology, circulatory shock—a scarcely less interesting problem for physiology, and finally the formation and reabsorption of edema.

Clear in conception, method and presentation, and beautiful in the technique both of the laboratory and of the printing press, this book is indeed a worthy addition to the scientific classics which have been published as Silliman lectures. It presents investigations already crowned by the Nobel prize.

YANDELL HENDERSON
YALE UNIVERSITY
NEW HAVEN, CONN.

Tobacco and Mental Efficiency. M. V. O'SHEA. Macmillan Company, 1923, pp. xx and 258.

THIS is a general and popularly written report of the outcome of various inquiries supported by the "Committee to Study the Tobacco Problem." It is an unbiased account of the present state of our knowledge concerning the title subject.

The first third of the book gives an interest-