secretory products, and hence indirectly as well as directly are concerned in maintenance of normal structure. Conceivably the "fields" under vitamin influence include cells other than those in which vitamins operate.

I acknowledge a hazy embryological perspective and admit my vagueness of ideas, yet it seems to me that the morphological responses to vitamin deficiencies should in a very limited way influence thought in research upon embryonic organization and, in particular, postnatal differentiation of tissues. More limited perhaps in possibilities for such purposes than the hormones, the vitamins offer more direct attack or easier isolation of phenomena in forms amenable to research.

A number of problems involving cells and tissues primarily affected by vitamin deficiencies can be made easier of approach by making use of the facts that we can retard, suppress and release at will some tissue activities, including growth of cells, source, maintenance and formation of intercellular materials, calcification of bone and cartilage, compensatory hyperplasias, and other applications, all of which have been mentioned in their appropriate setting.

The observations submitted may seem trivial in relation to the broad front of attack upon the problems indicated, but none the less they are interesting and thought-provoking. For the *how* of vitamin deficiency consequences, demonstrated morphological sequences only can be offered; for the *why,* retreat to two refuges or expedients I have long employed in teaching—certain invariable histological sequences in pathology and the conviction that all pathological processes subsequent to injury recapitulate normal events of growth.

AWARD OF THE MEDALS OF THE ROYAL SOCIETY[1]

By Sir WILLIAM BRAGG
PRESIDENT OF THE ROYAL SOCIETY

SIR HENRY DALE is awarded the Copley Medal. His most important contributions to physiology and pharmacology lie in two different but closely related fields: (1) the isolation of certain chemical substances, notably histamine and acetylcholine, from animal tissues, and (2) the discovery of the part played by these in a large number of important physiological and pathological processes.

His earlier work (1905–11) on the active principles of ergot led to progress in many allied subjects. The study of histamine, isolated from ergot extract and later found as a normal constituent of certain tissues, has modified profoundly our views of the capillary circulation and of the conditions known as "wound shock" and "anaphylactic shock." In 1914 he became interested in the choline esters, and with extraordinary prescience singled out acetylcholine as the most interesting member of the series and pointed out the extreme likeness of its action to that of stimulating the parasympathetic.

In 1924, Loewi demonstrated that a substance indistinguishable from acetylcholine is liberated by the heart when the vagus nerve is stimulated. The researches of others, prominently among them Dale himself and his colleagues, have since shown that acetylcholine is liberated at many other junctions between conducting tissues, and the results with acetylcholine and adrenaline are embodied in the description of nerves as "adrenergic" and "cholinergic." Recently convincing evidence has been given by Dale and his collaborators that acetylcholine plays an important, possibly an essential, part in the transmission of impulse from nerve to voluntary muscle: a discovery which has direct practical bearings on muscular fatigue and in various pathological conditions, and also is of the greatest interest [illegible]he theory of the mechanism of the nervous and n[illegible]omuscular systems.

As director of [illegible]e National Institute for Medical Research, Dale h[illegible]s inspired and directed a wide variety of investi[illegible]tions outside his special field, and numerous invest[illegible]tors from many countries have worked under his guidance.

A Royal Medal is awarded to Professor Nevil Vincent Sidgwick. He has always been primarily interested in the causes which determine molecular structure, and his earlier experimental work chiefly dealt with such subjects as tautomerism, and the vapor pressures, boiling-points and solubilities of isomerides. The development of the conception of the nuclear atom, more particularly by Bohr and Moseley, made possible for the first time a quantitative treatment of chemical valency other than purely formal, and the first steps in this direction were taken by Langmuir, G. N. Lewis and Kossel during, or just after, the war. Others followed with theoretical or physical extensions.

Sidgwick's post-war experimental work has all been concerned with particular problems of structure, utilizing to the full available physical methods of attack. To take a few examples, he has shown the existence

[1] Made at the anniversary meeting, Burlington House, London, November 30, 1937.

of coordination compounds of the alkali metals, and has demonstrated the coordinating properties of the hydrogen atom. In particular, it was he who distinguished clearly the existence of a third and very important type of chemical binding, the so-called coordinated covalent link.

In 1927, he published "The Electronic Theory of Valency," in which, for the first time, the most diverse structural phenomena covering the whole field of chemistry were rationally systematized. The book met with immediate and enthusiastic acceptance in all quarters. In 1928, he played a leading part at a conference held at Munich to discuss chemical binding in its relation to atomic structure. In 1931, he lectured in the United States of America. His second book, "The Covalent Link in Chemistry," which appeared in 1933, is based on the course then given and, like the first, has proved effective and stimulating to a high degree. In late years he has continued his work of fruitful interpretation in a series of remarkable contributions made to the Annual Reports of the Chemical Society, and in his recent presidential addresses to the same society on the subject of "Resonance Phenomena in Chemistry."

A Royal Medal is awarded to Dr. Arthur Henry Reginald Buller. He was professor of botany in the University of Manitoba from 1904 to 1936. His original contributions to science are mainly in the field of mycology and have been published in his "Researches on Fungi." Six volumes of these researches have appeared, the first in 1909, the sixth in 1934, and he is now engaged in the preparation of further volumes.

These researches fall into two groups. The first comprises studies on the morphology, biophysics and physiology of the higher fungi, including the physiology of the mycelium and the organs produced on it, and especially of the production and liberation of spores. The second group deals with sex in the higher fungi, and his studies on this subject rank among the most important that have been made. Particular mention should be made of his observations on the process of diploidization in the higher fungi, and of the discovery, in conjunction with his student Craigie, of heterothallism in the rusts. This work has revolutionized our conception of the life cycle of these forms. Buller's studies have not been confined to one group of fungi, but include researches on Discomycetes and many groups of the Eu-Basidiomycetes, as well as on rusts and smuts. Reference should also be made to his "Essays on Wheat" and to his efforts which made possible the publication of the translation by his friend, W. B. Grove, of the monumental "Selecta Carpologia Fungorum" of the brothers Tulasne.

During his thirty-two years of occupation of the chair of botany at Winnipeg, he has been a leading figure in Canadian botany, and was president of the Royal Society of Canada in 1927 and 1928. Since his retirement he has continued his researches in this country.

The Davy Medal is awarded to Professor Hans Fischer. During the past twenty-five years he has been continuously engaged in the study of the chemistry of the porphyrins, the bile pigment and chlorophyll. Starting from the knowledge that the porphyrin molecule was built up of pyrrole nuclei, variously substituted in the different porphyrins, Fischer developed controlled methods of degradation which extended the possibility of the identification of the pyrroles contained in any given porphyrin.

With the accurate information acquired in this manner as a basis Fischer proceeded, by bold and original synthetic work, artificially to prepare a large number of porphyrins of known structure, many of which proved to be closely related to or identical with natural products; his crowning achievement in this field was the synthesis of protoporphyrin, which, with iron, yielded haematin identical with that derivable from blood haemoglobin.

From the porphyrins Fischer turned his attention to the bile pigments and was able to explain the fundamental chemical features of their relationship to haemoglobin, thus paving the way for the biochemical work which is now proceeding in other laboratories and which promises to explain the actual mechanism of bile pigment formation in the body.

In recent years Fischer has applied his brilliant synthetic technique with outstanding success to the elucidation of the detailed structure of chlorophyll; his work in this field continues at the present time.

The Buchanan Medal is awarded to General Frederick Fuller Russell. He graduated from Columbia College of Physicians and Surgeons in 1893, and began his career as a member of the Medical Corps, U. S. Army, in 1898, advancing through the various grades to that of colonel in 1917. He resigned in 1920. He was curator of the Army Medical Museum, Washington, D. C., from 1907 to 1913, and also instructor in bacteriology and clinical microscopy at the Army Medical School, where he performed distinguished service in developing and producing the typhoid vaccine which the Army has used with great effectiveness since that time. He was professor of pathology and bacteriology at George Washington University School of Medicine from 1909 to 1913 and for the following year lecturer in tropical medicine at the New York Post-Graduate Medical School and Hospital. From 1915 to 1917 General Russell was

chief of the Board of Health laboratory in Ancon, C. Z., and during the world war was in charge of the division of infectious diseases and of the laboratory service of the surgeon-general's office, U. S. Army. From 1920 to 1923 he was director of the public health laboratory service of the International Health Board, and from 1923 to September 1, 1935, he was general director of the board. In 1919 he received the Distinguished Service Medal. Recently he was appointed lecturer on preventive medicine and hygiene and epidemiology at Harvard Medical School, Boston.

It was during the period while General Russell was director of the International Health Division of the Rockefeller Foundation that the foundation gave such material aid towards the establishment of schools of hygiene in various European countries. They also contributed largely to the All India Institute of Hygiene in Calcutta and to the Singapore Medical School. General Russell was also responsible for establishing the yellow fever unit in West Africa. Large grants were given to the Health Section of the League of Nations, and the fellowship scheme under the International Health Division was considerably extended. The policy of the foundation in these matters was moulded in no small degree by General Russell, whose influence on the development of public health services all over the world has been altogether remarkable.

The Sylvester Medal is awarded to Professor Augustus Edward Hough Love. He is most generally known as the author of the "Treatise on the Mathematical Theory of Elasticity," which has attained a universal reputation and remains the standard work of reference on this subject all over the world.

Before the first edition of the treatise was published in 1893 (almost simultaneously with the completion of the publication of Todhunter and Pearson's "History of Elasticity"), this branch of mathematical physics received little attention, and its results were often regarded by engineers with suspicion. During the intervening years it has gradually established itself as one of the most reliable mathematical theories of continuous media and, unlike its sister science of non-viscous hydrodynamics, its results have been increasingly verified in practice. That this has come about is due in great part to the influence of Love's "Treatise," which, indeed, like Lamb's "Hydrodynamics," is far more than a mere treatise and embodies a vast amount of original work.

In other of his published work there is a great volume of research dealing not only with elasticity, but with hydrodynamics and electromagnetism. His earlier work was mostly on hydrodynamics, particularly vortex motion and wave-motion. He returned also at various times to electrical problems, especially those relating to the propagation, scattering and transmission of electric waves. His elastical investigations range over an exceedingly wide field, from the equilibrium of beams and plates of various shapes to the study of vibrations in a variety of difficult cases and to the applications of the theory of elasticity to problems connected with the earth.

An enumeration of Love's researches, even when restricted to the more important ones, would be too long to attempt in this brief account; but two of them may be explicitly mentioned.

The first of these is the powerful and elegant theory of the support of the continents, of earth-tides and seismic waves and of the elastic stability of the earth, developed in his Adams Prize Essay of 1911, "Some Problems of Geodynamics," where appears for the first time his explanation of the seismic waves vibrating horizontally and transversely to the direction of propagation, waves to which Love's name is now universally attached.

The second is the remarkable paper on biharmonic analysis in a rectangle, published in the Proceedings of the London Mathematical Society in 1929. In this paper Love gives a complete solution of the biharmonic equation subject to given boundary conditions over the perimeter of a rectangle, thus solving at any rate the two-dimensional form of a problem which was described by Lamé as "le plus difficile peut-être de la théorie de l'élasticité," and had till then baffled mathematicians.

The Hughes Medal is awarded to Professor Ernest O. Lawrence, professor of physics in the University of California, the inventor (1932) of the cyclotron, the most important instrument of physical research since the C. T. R. Wilson expansion chamber. By its means ions are accelerated in a magnetic field and move within two half-cylinders which change electrical polarity in rhythm with the circulating ions, so that deuterons have been spirally speeded in a vacuum to velocities due to three million volts. These deuterons, impinging on beryllium, have produced neutrons and protons in great number, and some of the protons have been projected through the equivalent of forty centimeters of air. Many elements have been proved to be radioactive when thus bombarded by high-speed protons or deuterons.

Hydrogen molecular ions have been used also as bombarding elements with velocities due to five million volts. Such high-speed ions are available for developing the theory and practice of atomic disintegration, and Professor Lawrence and his co-workers are playing a leading part in this development.