the real problems concerning the nature and existence of elementary particles cannot be met and attacked within the domain of electrodynamics.

Other theoretical papers were read by Prof. F. Bopp of Munich, Prof. L. Jánossy of Dublin, Prof. M. Fierz of Basle, and by Sir Charles Darwin. Prof. Bopp presented a new method for formulating the dynamics of particles interacting with an electromagnetic field, when the Lagrangian of the system involves not only particle velocities but also accelerations; he is able to quantize this formalism, and to obtain from it various elegant consequences; however, the quantized theory is not yet completely worked out and adapted for practical use.

At the end of the theoretical programme, Sir Charles Darwin put forward some radical speculations concerning the origin of cosmic rays, which aroused widespread discussion. He first proposed for consideration the phenomenon of pitting of marine propeller-blades as a result of cavitation at the surface of the blades; in this phenomenon a small hemispherical cavity in the water is supposed to collapse in a symmetrical manner, and it follows from the laws of hydrodynamics that a very small mass of water in contact with the blade will arrive at the centre of the cavity at the instant of collapse with an immensely high velocity. He suggested that the origin of cosmic rays be sought, not in any thermodynamically stable process, but in some violently non-thermodynamical and co-operative phenomenon such as he had described. Pushing a little farther the analogy with cavitation, he proposed for investigation the possibility that cosmic rays could be generated in the collapse of large vacuous regions formed by the turbulent motions in stellar atmospheres [see also *Nature*, December 31, p. 1112]. Sir George Thomson, however, pointed out that because of the well-known order of magnitude of the cosmic-ray flux, either the generation process in stars must be unreasonably efficient, or else the generation must be taking place in our own sun.

Present at the conference were about a hundred physicists, representatives of ten countries. Russian physicists, who also had been invited to attend, were absent. However, at one of the sessions Prof. Born read a telegram which he had received from Prof. Vavilov, president of the Academy of Sciences of the U.S.S.R., apologizing for not sending a delegate and expressing friendly interest in the proceedings of the conference.

OBITUARIES

Prof. D. R. Hoagland

THE death of Dennis Robert Hoagland, professor of plant nutrition in the University of California, Berkeley, has removed an illustrious plant physiologist and one of the world's leading authorities in the broad field of plant and soil interrelations. For more than thirty years he laboured with distinction and devotion toward the understanding of the extremely complex plant–soil–atmosphere system as it exists in Nature.

Hoagland was born in Golden, Colorado, and received his early education in Denver. In 1903 he went to study chemistry at Stanford University. Following a distinguished undergraduate career he first elected to go on with advanced work in chemistry; but in 1908 he accepted a position in the Laboratory of Animal Nutrition in the University of California. The new position brought him for the first time in professional contact with biology and took him to Berkeley, where, except for a few short gaps, he was to spend the rest of his life.

Hoagland remained in the field of animal nutrition for five years, the last of which he spent in research under Prof. E. V. McCollum, of the University of Wisconsin. In later years, Hoagland looked back on his association with Prof. McCollum as his real inspiration for a life devoted to scientific research. There would normally have been every expectation that he would continue in this field, but circumstances intervened and the acceptance in 1913 of a position as assistant professor of agricultural chemistry brought him back to Berkeley and was the initiation of his work in plant nutrition.

One of his early research activities concerned itself with the effect of hydrogen-ion concentration on plant growth. It was with great surprise that he discovered that, contrary to the then accepted tenets of agricultural teaching, barley plants made excellent growth at *p*H 5. It was apparent that the inherent complexity of soils rendered untrustworthy many sweeping generalizations based on local conditions. He became convinced that the complex problem of soil and plant interrelations could best be studied by techniques which permitted rigid experimental control and the isolation of individual variables. He afterwards developed to a very high degree the water-culture technique for growing plants which has since, for more than three decades, served as a powerful and discriminating tool for studying fundamental problems in plant physiology at Berkeley. In later years he was also instrumental in securing one of the first experimental chambers in the United States for the growing of plants under reproducible conditions of light, temperature and humidity.

His early and dominant research interest was in the process of absorption and accumulation of ions by plants. The quality of the immense contribution which he, with his collaborators and associates, made to this fundamental process of plant physiology can only be judged against a background of the ideas and concepts which prevailed when his work got under way. There was no clear view as to how inorganic elements are absorbed by plants. Discussions of this subject were usually invoking such concepts as osmosis, permeability, antagonism, none of which, as he later clearly demonstrated, could explain their absorption, accumulation and retention against a concentration gradient of anions and cations by plant cells.

Hoagland first became interested in the special nature of ion absorption by plants during the First World War, when during a search for domestic sources of potassium, he discovered the remarkable ability of the giant kelps of the Pacific Coast to accumulate potassium and iodine many times in excess of the concentrations found in the sea. He returned to this problem several years later, using first intact barley plants and, later, a unicellular fresh-water alga, *Nitella*. This work clearly demonstrated that absorption of ions by plants is a metabolic process requiring energy and not a question of simple permeability. His work with *Nitella* allowed him to paint in bold strokes a theory which at once correlated a host of observations in the field and laboratory and made it possible to approach an infinitely complex subject with principles instead of mere empirical observations. The next phase of his researches on ion accumulation brought him closer to the system which was uppermost in his mind—the absorption of nutrients by the roots of higher plants. Using excised barley roots of known and reproducible physiological status, an impressive array of results was amassed on the influence of light, temperature, *p*H, ion selectivity, concentration of ions in the external medium, differences in rates of absorption and the effect of one ion on the absorption of another. A striking correlation was obtained between the supply of oxygen and the absorption of salts by roots against a concentration gradient. A solid scientific foundation was thus laid for the understanding of the importance of aeration in soils and for the interpretation and prediction of a multiplicity of plant responses to fertilization treatments and other chemical changes in the soil. The final phase of his investigations on absorption of ions occurred just before and during the Second World War, when many of his earlier conclusions were confirmed and extended with the use of the sensitive technique of radioactive isotopes.

Dominant as his life-long interest in the process of ion absorption was, it by no means prevented him from pursuing with vigour other phases of plant nutrition to which he, with his associates, made outstanding contributions. He studied by means of different techniques, including some of the earliest application of radioisotopes, the upward movement and distribution of inorganic solutes in the plant. He was keenly interested in problems of soil chemistry in so far as they affect the nutrition of crops grown in the field. His own work was especially concerned with zinc, potassium and phosphate deficiencies of fruit trees in California. He contributed to the identification of one of the most important physiological diseases of fruit trees in California, 'little leaf', with zinc deficiency, and reproduced it under controlled greenhouse conditions. His investigations of potassium nutrition had a bearing on 'prune dieback', another nutritional disease of fruit trees in California, and led to extended studies of the chemical aspects of potassium availability in soils. His interest in the nutrition of fruit trees continued, and in 1940 he produced, under controlled conditions, the first molybdenum-deficiency symptoms in a fruit tree species.

Hoagland's entire life as a productive scientific worker was spent in association with agricultural research. He had a profound faith in the importance to agriculture of fundamental research, without thought and expectation of immediate practical returns. He was fully aware of the often wide gap between laboratory result, obtained under controlled conditions, and the field application, complicated as it is by a multiplicity of factors. He was conscious not only of the promise but also of the limitations of science in agriculture. In dealing with living plants and animals he was mindful that "it still takes the wheat plant six or nine months to develop and cows bring forth their calves neither more quickly nor more numerously for us than they did for Abraham". He believed that the contribution of science to agriculture must be judged not only by its material achievements but also by the enlightenment it proffered to the farmer and city dweller alike about the intricacies of plants and soils. Though a chemist by training, he acquired early the outlook of a biologist and was mindful of the inherent complexity of biological systems, their adaptive properties to varying conditions, and hence he distrusted the spectacular short-cut or facile generalization unless it was supported by solid experimental evidence.

Hoagland's chief characteristic, whether in scientific matters or personal relationships, was integrity and objectivity of outlook. In evaluating scientific evidence he had the "four things" which Socrates said "belong to a judge: to hear courteously, to answer wisely, to consider soberly, and to decide impartially". He applied the same critical standards to his own work as to that of others. He accepted no blanket authority in science, and expected every single piece of research to stand on its own merits regardless of its source. In personal relationships he possessed the engaging quality of always seeking the good in men and their work. In approaching students, he had a rare gift of making them sense the good-will and confidence in their ability with which he always credited them at the start. His students were spurred to special efforts by a desire to prove themselves worthy of his trust. Hoagland's confidence and friendship once given were not easily withdrawn. Never demonstrative in manner, he had a deep loyalty and an unfailing concern for the welfare of his friends and associates.

Hoagland was the not altogether common scientist who carried the scientific mode of thinking outside his own speciality into diverse areas of human thought and achievement. He maintained an active interest not only in many departments of science but also in fundamental questions of education and in the social and political problems of the contemporary scene. It was a stimulating experience to witness his well-stocked mind analyse a complex issue with clarity and insight which unerringly penetrated to the root of the matter. Whatever the subject may be, his discussions had a special flavour of emotional and intellectual maturity which excluded bias and preconceived notion. In the seventeen years during which I was associated with him as a student, colleague and friend, I never once heard him discuss a person or an issue, scientific or otherwise, except in a fair and objective manner.

It is only natural that his accomplishments, his qualities of mind and character gained him wide recognition and many honours. His counsel was sought and valued within his own University, to which he gave unstintingly of time and effort in many arduous administrative assignments, usually at the expense of his own leisure and in later years at the expense of his health. In 1934 he was elected a member of the National Academy of Sciences. The American Society of Plant Physiologists, which was his closest scientific affiliation, bestowed upon him its highest honour by granting him, in 1929, the first Stephen Hales award in recognition of his outstanding research contributions. He was also elected president of the Society and occupied other important offices in it.

The high esteem in which he was held by plant physiologists throughout the world is attested by his recent appointment as president of the Section of Plant Physiology at the forthcoming Seventh International Botanical Congress to be held in Sweden in 1950. Unfortunately, poor health forced him to decline this international honour.

Many other societies in which he held membership honoured him in various ways. In 1940 the American Association for the Advancement of Science awarded him the 1,000 dollars prize for an outstanding paper presented at the Philadelphia meetings. In 1942 he was invited by Harvard University to give the John

M. Prather lectures. The lectures were later published in book form, and constitute the only book which he found leisure to prepare.

His own colleagues in the various faculties bestowed upon him the highest honour within the University, by appointing him faculty research lecturer in 1942.

Hoagland was never in robust health; but a strong sense of duty compelled him to carry on without a thought for his own personal well-being. The last four years of his life were marred by serious illness. He carried on with courage and determination to within the last few months of his life, when his eyesight failed him almost completely. This latter blow was the severest of all, for throughout his life he enjoyed reading on a wide variety of subjects. It was characteristic of the man that once he gave up hope of regaining his health he requested retirement from the University, ignoring the serious financial adjustment that such a voluntary step would involve. He was officially retired on July 1, 1949, and died almost two months later.

In 1920 he married Jessie A. Smiley. She died suddenly of pneumonia in 1933. He was left with the responsibility of bringing up three young boys. His three sons, his mother and a brother survive him.

The scientific influence of Prof. Hoagland's life has not come to an end with his death, but will continue through the deep impression which he made on the minds and hearts of his students and friends.

DANIEL I. ARNON

WE regret to announce the following deaths:

Mr. Joseph Bailey, formerly of the Ministry of Education, sometime president of the Museums Association, on January 4, aged eighty-nine.

Dr. Isaiah Bowman, president since 1935 of Johns Hopkins University, on January 6, aged seventy-one.

Prof. Stefan Meyer, one of the pioneer workers in radioactivity and for many years director of the Vienna Radium Institute, on December 29, aged seventy-seven.

NEWS and VIEWS

Wool Industries Research Association: Dr. A. B. D. Cassie

THE announcement that Dr. A. B. D. Cassie has been appointed director of research of the Wool Industries Research Association will be received with satisfaction by his many friends in academic and industrial life. A graduate in mathematics and physics of the Universities of Edinburgh and Cambridge, he first carried out research in Prof. F. G. Donnan's laboratory at University College, London. In conjunction with C. R. Bailey, he published some twenty papers on the infra-red spectra and structure of triatomic molecules, and then in 1934 joined the staff of the Dyestuffs Division of Imperial Chemical Industries. During the following two years, he introduced dielectric and power-loss methods of indicating the state of aggregation of fillers in rubber, and then transferred to the Royal Aircraft Establishment, where he worked with Sir Ben Lockspeiser until his appointment as chief physicist at the Wool Industries Research Association in 1938. Since that time his special interest has been the adsorption of water vapour by textile fibres. After studying the simultaneous propagation of heat and water vapour through hygroscopic textiles, which provided a clear indication of the physical properties associated with the warmth of clothing, he made an important contribution to the theory of water adsorption by textile fibres by giving the first statistical derivation of Brunauer, Emmett and Teller's adsorption isotherm. More recently, he has devoted his energies to water-repellency, and his elegant work in this field, by directing attention to the importance of surface structure, has served to explain several unusual phenomena associated with plant and animal surfaces. For these and other investigations he was awarded in 1946 the Warner Memorial Medal for investigations in textile technology. Dr. Cassie succeeds Mr. B. H. Wilsdon as director of research during a period of expansion of the buildings and equipment of the Research Association, and their previous close association will ensure continuity of development during a critical phase in the history of the wool textile industry.

Research on Cortisone and Related Substances at Oxford

IN *Nature* of December 31, p. 1117, it was announced that the Nuffield Foundation had made a grant to the University of Cambridge for research on adrenocorticotropin in pursuance of the special interest it has shown in work bearing on the causes and cure of rheumatism. A parallel grant, of £10,000, has also been made to the University of Oxford for a study of the synthesis of cortisone and its analogues in the Dyson Perrins Laboratory under the supervision of Sir Robert Robinson. Although it is probable, as Sir Robert has himself stated in his presidential address to the Royal Society (*Nature*, December 17, p. 1025), that synthesis of Li's peptide hydrolysate of adrenocorticotropic hormone offers the better approach, the attack on cortisone itself must also be made. The problem is one of great difficulty, and the preparation of cortisone has hitherto been effected only from material of natural origin, such as the desoxycholic acid of bile. This is hopeless for large-scale working and is said to require no less than thirty-five stages. Synthesis from a plant sapogenin, namely, sarmentogenin, about halves the number of stages, but this also is an unattractive proposition. The complete synthesis seems a more or less hopeless quest, but it is hoped at Oxford to make two kinds of substitutes. The first would be a near analogue such as might result from work among molecules rather closely related to cortisone. The second would be an analogue in which the cortisone structure is simulated in a much simpler structure. In other words, one objective of research is to find the substance that will bear the relation to cortisone that stilbœstrol bears to œstradiol. The feasibility of this cannot be assessed at this time, because we do not know how narrowly specific may be the constitutional–physiological relationship.

Tsetse Control in the Gold Coast

DR. KENNETH MORRIS has been appointed director of the newly established Tsetse Control Department, Gold Coast; this Department has arisen out of the trypanosomiasis campaign, which was an offshoot of