

*vitro*. However, it is the Sardinian strain which is more efficient in resisting other chlorinated hydrocarbon insecticides, including dieldrin and aldrin, which are difficult to hydrolyse (if we are to judge from results *in vitro*). Furthermore, the resistance of the Italian strain to the early knock-down by DDT cannot be related to a more rapid dehydrochlorination, for Wintringham<sup>5</sup>, who worked with this strain, found that it metabolized DDT very slowly (only 23 per cent in 5 hr.).

As earlier writers have suggested, the dehydrochlorination mechanism does not fully account for DDT resistance, and one is driven to postulate an additional defence mechanism. This would partially explain my results, assuming that the unknown mechanism predominates in the Italian strain, while the Sardinian strain relies mainly on dehydrochlorination.

<sup>1</sup> Sacca, *Riv. di Parasitol.*, **8**, 127 (1947).

<sup>2</sup> Harrison, *Bull. Ent. Res.* (in the press).

<sup>3</sup> Busvine, *Discovery* (March 1950).

<sup>4</sup> Busvine, *Ceylon J. Med. Sci.*, (D), **4**, 1 (1949).

<sup>5</sup> Critsol, *J. Amer. Chem. Soc.*, **67**, 1494 (1945).

<sup>6</sup> Sternburg *et al.*, *J. Econ. Entom.*, **43**, 214 (1950).

<sup>7</sup> Perry and Hoskins, *Science*, **111**, 600 (1950).

<sup>8</sup> Wintringham *et al.*, *Nature*, **167**, 106 (1951).

## CARNEGIE INSTITUTION OF WASHINGTON

### ANNUAL REPORT FOR 1949-50

THE annual report for 1949-50 of the Carnegie Institution of Washington\* includes the report of the president of the Institution, Dr. Vannevar Bush, as well as those of the executive committee and the auditors, and also the yearly record of departmental activities and co-operative studies.

The feature of the president's report is the discussion of the nature of research, and especially the methodology of the basic scientific research with which the Institution is primarily concerned. This is defined as the effort to extend, for its own sake, our grasp of the workings of Nature and of man, while applied research seeks to produce a new and useful device, material or process by capitalizing the growing body of fundamental knowledge. In both types of research there are two general approaches. One is to improve the tools, including the use of mathematical analysis, and usually proceeding by refinement, painstaking examination of sources of error and by testing of available materials. In the second a concerted attack is made upon a specific problem, applying all possible methods and instruments, and creating new ones for the purpose. Dr. Bush points out that even the objective centralized attack often turns the investigator into unexpected paths, and it is essential to keep in mind the true relation between the man of science and the instruments he uses. These are aids, not objects, and are important only as they foster the creative activity of the investigating mind. What distinguishes the really great man of science is the ability to sense or discern those places where truly great significance lies and where the tools available can open up a really wide crack in the wall of the unknown. More than forty years of experience has justified Andrew

\* Carnegie Institution of Washington. Year-Book No. 49, July 1, 1949-June 30, 1950, with Administrative Reports through December 15, 1950. Pp. xxxvi+220+7 plates. (Washington, D.C., 1950.) 1 dollar.

Carnegie's conviction that an institution which sought out the unusual scientific worker and made it possible for him to create to the utmost would be worth while.

Reviewing the research activities of the year, Dr. Bush refers to the publication during the year by Dr. R. E. Wilson and Dr. A. H. Joy of the radial velocities of 2,111 stars, thus essentially completing a programme begun by the Mount Wilson Observatory in 1910 which has yielded velocities of about 14,000 stars of all spectral types. During the year the 200-in. Hale telescope and the 48-in. Schmidt camera took their place with the 100-in. and 60-in. telescopes on Mount Wilson on the regular observing schedules of the Observatories. On June 26, 1949, Dr. W. Baade with the 48-in. Schmidt camera discovered the trail of a very unusual asteroid which has now been found to possess the shortest period (409 days) of any known asteroid and comet and has been named Icarus.

At the Geophysical Laboratory of the Institution careful measurements on about three hundred specimens of quartz have shown easily measurable differences in the behaviour of crystals from granite and those believed to have been formed in the later stages of igneous activity. Measurements on the effect of pressure on the inversion-point of quartz indicate that at the maximum pressure reached—corresponding to a depth of twenty-miles below the surface of the earth—the inversion-point is raised by more than 200° C. Further work on the feldspars has yielded quantitative information on their co-existence and stability, and the conditions of temperature and pressure under which they have been formed. Measurements on the melting of silicates in the presence of water under pressure have also continued, and the high-pressure steam filter autoclave has been further developed. Studies, in co-operation with the Department of Terrestrial Magnetism, of the earth's crust using waves produced by large explosions resulted in agreement that the velocity of earthquake waves is 5.9-6.0 km./sec. and also, reducing our estimate of the thickness of the upper layer, bring into agreement the shear-wave arrival times for near earthquakes. The same Department has continued its measurements of the residual-magnetism properties of sedimentary rocks, and studies on the direction of easiest magnetization indicate that these directional magnetic properties had their origin when the rocks were laid down as sediments. A great increase of cosmic rays coincident with a great solar flare was again observed; these high-energy radiations appear to be a nucleonic component of cosmic rays coming to the earth from the vicinity of the sun, and the observed particles are not mesons. The study of proton-proton scattering has continued, and, as a result of biophysical studies using radioactive tracers on the effect of inorganic ions on cellular activity, the ability of organisms to concentrate potassium from their environment can be interpreted in terms of the formation of relatively stable potassium compounds within the cell.

Investigations on photosynthesis, in the Division of Plant Biology, have been concentrated primarily on the photochemical part of the reaction by which the light absorbed by the various chloroplast pigments is converted into chemical energy. It has been found that the fluorescence spectra of red algae do not match the summations of the fluorescence spectra of their purified pigments, although the different pigments do function to some extent independently. A

highly fluorescent pigment, present in the cells which surround the so-called guard cells controlling the openings through which gases enter the leaves of certain species of vetch, possesses a fluorescence spectra resembling those of certain types of porphyrins. A mutant of *Chlorella* has been found which contains chlorophyll, but is incapable of reducing carbon dioxide, although it can evolve oxygen when illuminated. Chloroplast experiments have shown that the reactivation by precipitation of disintegrated chloroplast material depends primarily upon the physical state of the precipitate, and similar results have been obtained by treatment with various salts, by increased acidity, and by very low concentrations of streptomycin, which combines specifically with the chloroplast material. Methods have been worked out for separating uronides from leaves, and it appears possible that the great variations, independent of photosynthesis or respiration, of sugar concentration in leaves, may be associated with a reversible formation of uronides, which ties up the sugars. The principles controlling the evolution of plants have been studied by examining the growth of contrasting climatic races under varied temperatures in controlled greenhouses at the California Institute of Technology. The *Poa* grasses included with hybrids of *Achillea* and *Mimulus* in these studies were also used in studies of the influence of environment on chromosomal pairing.

In the Department of Embryology of the Carnegie Institution one of the chief advances on the anatomical side has been the achievement of sex reversal of the gonad in the opossum by experimental treatment in the embryonic stage with the female sex-hormone  $\alpha$ strogen. A detailed study of the embryonic development of the external muscles of the human eyeball was being prepared for publication, and studies on the developing brain and liver, with respect to chemical factors in the synthetic activities which characterize foetal growth, indicate that specific chemical changes can be correlated with changes in the form of the developing nerve cells as seen under the microscope. The investigation on the physiology of the uterus has led to the development of the multi-channel tokodynamometer, by which obstetricians can record the contraction of all parts of the human uterus in childbirth and distinguish normal patterns of contraction from abnormal types which do not permit smooth and properly timed passage of the infant. Studies of the action of drugs upon the uterus were being continued, and an investigation of the biochemistry of uterine muscle in relation to the functional states of the reproductive system has shown that the presence of an effective amount of actomyosin in the uterus depends upon the ovarian sex hormone or  $\alpha$ strogen.

## TEA RESEARCH INSTITUTE OF EAST AFRICA

A NEW research institute concerned with problems bearing on the cultivation and manufacture of tea has been inaugurated at Kericho, Kenya Colony, to serve tea producers in the three East African territories. Well-equipped laboratories have been built and a nucleus staff is in residence. At present the activities of the Institute are divided between a general agricultural department, covering agronomic

and pathological problems, and a chemical department concerned with soils and plant biochemistry.

The funds for the support of the Institute are provided by the territorial Tea Boards of Kenya, Tanganyika and Uganda, which were recently established by legislative ordinances for the regulation of tea production, marketing and export.

Following the example of the British Grassland Research Station, the Institute has been incorporated as a company limited by guarantee without share capital, in Kenya, thus obviating the necessity for parallel legislative action in three territories of different constitutional status.

The governing body consists of ten members, six of whom (two from each territory) are nominated by the Tea Boards to represent producers, the remaining four being the directors of agriculture in the territories and the director of the East African Agriculture and Forestry Research Organization. The latter, Dr. B. A. Keen, has been elected chairman. During the preliminary stages of establishment, pending the working out of a constitution, the affairs of the Institute were sponsored by Messrs. Brooke Bond and Co., Ltd. On this account buildings and development generally were able to proceed without delay.

The tea industry in East Africa is relatively young and dates back about twenty-five years. The approximate acreage of mature tea in East Africa is 33,000, with a production of 19,000,000 lb. in 1950. East Africa has contracted out of the international agreement for restriction, and production is expanding. The immediate problems for a research institute are therefore largely concerned with soil and fertility conservation, establishment of young tea and the improvement of types of tea by selection.

## DEVELOPMENT OF THE MAMMALIAN LYMPHATIC SYSTEM

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THE problem of the development of the lymphatic system in the mammal still remains unsettled. Sabin<sup>1</sup> regards the lymphatic vessels as direct derivatives of the embryonic veins. The lymphatic vessels make their first appearance at the four centres of radiation in relation to limb girdles. By the process of continuous and uninterrupted sprouting they extend centrifugally and invade almost the entire body. Lewis<sup>2</sup> believes that the lymphatic vessels are formed by the confluence of multiple venous outgrowths. These venous derivatives have previously become detached from the main venous channels and later they transfer *in toto* to the lymphatic system. Huntington<sup>3</sup>, Huntington and McClure<sup>4</sup> and Kampmeier<sup>5</sup> have shown that the systemic lymphatic vessels are formed by fusion of the perivenous mesenchymal spaces. These spaces develop as separate lymphatic anlagen outside the intima of the early venous channels. They do not communicate directly with the veins except at definite points in the lymphatico-venous connections which are secondarily formed. The connecting segments between the veins at the root of the neck and the proper systemic lymphatic vessels are provided by the paired jugular lymph sacs.