

THE CARNEGIE INSTITUTION OF WASHINGTON

YEARBOOK 60 of the Carnegie Institution of Washington*, covering the year 1960-61, includes, besides the report of the president, Dr. Caryl Haskins, some features of which are discussed elsewhere (p. 1113 of this issue), the reports of departments and special studies and a bibliography of publications of the Institution. This is in addition to the bibliographies appended to the reports from the Mount Wilson and Palomar Observatories, the Geophysical Laboratory, the Departments of Terrestrial Magnetism, Plant Biology, Embryology and Genetics.

In his review of the year, Dr. Haskins, pointing out that four Departments were heavily committed to biological research and a fifth was carrying on very imaginative research in this field, notes the continuing work in the Department of Genetics on the operation of the suppressor-mutator gene control system where further studies have confirmed previous conclusions regarding the highly specific types of control exerted by this system and about the mode of operation of control systems in general. Methods which have been developed for isolating and characterizing deoxyribonucleic acid so as to avoid artificial breakage of the molecules and radioautographic measurements of the molecular weight of deoxyribonucleic acid isolated from phage-T2 indicate a molecular weight of 130 million with a length of about 52 μ .

Besides purifying deoxyribonuclease II from salmon testes, the Department has also identified chromosomal deoxyribonucleic acid in the primary spermatocytes of *Drosophila* by fluorescence microscopy and autoradiography. The role of heterochromatin has been brought into focus by an immunogenetic analysis of variegation in *Drosophila*, which revealed a change that occurs in an antigen when the white locus is brought by chromosomal rearrangement into the proximity of heterochromatin. In the Biophysics Section of the Department of Terrestrial Magnetism, work continued on the synthesis of ribosomes both on the time required for the material to flow through the precursor stages into the finished ribosomes and on the time required for the formation and loss of enzyme-forming systems. It was established that there is an eosome stage of precursor particles within the cells and a later neosome stage. The eosomes contain no protein, and the neosomes about one-quarter to one-half of the protein of the mature ribosomes, and the experiments suggest that the protein of the ribosomes is actually synthesized in the eosomes and neosomes. Kinetic studies of the induction of β -galactosidase in *E. coli* are also described at some length, and eight models for the mechanism of enzyme induction are compared.

In the Department of Plant Biology procedures were developed for obtaining aqueous extracts of chlorophyll-*a* complexes in their natural ratios, and close derivatives of some complexes have been separated by centrifugation. Procedures were also developed for extracting purified protochlorophyll-bearing particles and electron micrographs indicated that these particles are oblate spheroids with an

estimated molecular weight of about 1.4 million. Experiments with a red algae clearly showed the difference in the photochemical function of chlorophyll and of the accessory pigments, and the apparent inefficiency for photosynthesis of chlorophyll in red algae in comparison with that of phycoerythrin is attributed in part to the counterbalancing of photosynthetic oxygen evolution by the stimulated uptake of oxygen. Rates of apparent photosynthesis and of respiration of altitudinal races of *Mimulus* have now been measured from 0° C. to the highest temperature at which the experimental plants can function, and a selection experiment in *Achillea* involving study of the responses of cloned second-generation segregating progeny at the three transplant stations has been completed.

In the Geophysical Laboratory also, observations on the preferential fixing of carbon-12 as compared with the heavier carbon-13 during photosynthesis were extended to the culture of *E. coli* and the alga *Chlorella pyrenoidosa* with glucose as the sole source of carbon. The lipid fraction of these bacterial cells showed the same preferential fixing of carbon-12 relative to the carbohydrate fraction as in photosynthetic organisms, but the bulk of the remaining cell material had an isotopic composition similar to that of the glucose. Other studies suggest that it is unlikely that terrestrial-like life exists on the Moon, Venus or Mars. In the Department of Embryology the appearance of hypoxanthine dehydrogenase in the developing chick was studied in detail. Studies of the enzyme deoxyribonuclease in the developing frog have indicated all activity of one of the two types of this enzyme is associated with the digestive tract and has a generally synthetic function, while that of the other type is associated in the frog tadpole more with moribund processes. Using delicate grafting and culture techniques, a comparative study of the scale-producing areas (feet) and feather-producing areas of the chick body indicates that during the greater part of the life of the embryo the epidermis of feather-producing areas yields feathers when grafted on to the dermis of scale-producing areas, although the reverse is not true.

The Geophysical Laboratory has also undertaken physicochemical investigations of mineral systems for the information they can yield on crustal structure and processes, and has established that the form forsterite-albite does not exist at 30,000 atmospheres. Studies of the consequences of different distributions of radioactivity on heat-flow using an electronic computer suggest that thermal effects now observed at the Earth's surface are related directly to the total amounts of radioactivity in the outermost 400 kilometres; observed variations in flow reflect regional heterogeneities in total amount rather than the vertical distribution of radioactivity. Studies of melting behaviour and phase transformation of albite, enstatite and diopside under pressures up to 50,000 atmospheres indicate that no plagioclase can exist in the crust at pressures greater than 30,000 atmospheres. Work has commenced on the copper-iron-sulphur system and on the copper-iron-sulphur-oxygen system, and studies on the isotopic composition of lead from potassium feldspars indicate

* Carnegie Institution of Washington. Year Book No. 60; July 1, 1960-June 30, 1961. Pp. xi+535+29 plates. (Washington, D.C.: Carnegie Institution of Washington, 1961.) Cloth, 1.50 dollars; paper, 1 dollar.

that in the absence of metamorphism their lead content reflects the isotopic composition of their surroundings at the time when they were crystallized.

In the Department of Terrestrial Magnetism, an investigation was commenced to determine whether any significant statistical relation exists between geomagnetic activity, including the auroral currents in the ionosphere, and the intensity of the outer Van Allen belt along the Earth's radius. Besides investigations on cosmic rays and the Earth's crust and in radioastronomy, including solar studies, radio source positions and radiohydrogen, the Department has been active in developing facilities and programmes in radioastronomy throughout South America, conducted by South Americans trained through the facilities of the Institution. The work of the Mount Wilson and Palomar Observatories has included the discovery of nineteen supernovæ and the strongest magnetic field yet observed in Nature—that of the star *HD215441*. An investigation of the chemical composition of stars, nebulae and other objects brought to light many anomalies in the abundance of the chemical elements, the commonest deviation involving a deficiency in the heavy elements, including the common elements, all by about the same factor below their abundance in the Sun and nearby stars. A new comprehensive theory of the solar magnetic cycle was announced, which predicts a marked dependence of field intensity

on latitude, as a result of which the field becomes amplified to a critical value, exhibiting local instabilities, which commence about three years after the beginning of a sunspot cycle. In the study of radio signals, the spiralling and expanding hydrogen clouds surrounding and enveloping the stars of our own galaxy in the direction of the galactic anti-centre were intensively examined. Besides the optical identification of radio sources, the velocities in clusters of galaxies, the rate of star formation, the frequency of occurrence of metallic binary stars, the optical spectrum of non-thermal radio sources and the chemical composition of interstellar gas were also among the subjects of investigation at the Observatories.

The major emphasis of the Committee on Image Tubes for Telescopes during the year was on promoting the industrial development of magnetically focused image amplifiers, and during the year prototype image tubes became available for tests. Using magnetic focusing and fine-grain phosphorus of high resolving power, three types of image tubes can now be manufactured which provide a gain in sensitivity over traditional photographic methods by a factor of 10 or more, and these tubes have proved strikingly successful in aiding spectroscopic research and the investigation of double stars. A new procedure for aluminizing the 200-in. mirror of the Hale telescope on Palomar Mountain was also developed during the year.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE report* of the President of the Massachusetts Institute of Technology for 1961 has something of the quality which characterizes the reports of the Presidents of the Rockefeller Foundation and the Carnegie Institution of Washington, even to the extent of an awareness of the contribution which such an institution can offer to the development of the emerging nations that universities in Britain might do well to note. Beginning his review with some comments on the Institute's centennial celebrations in the spring, Dr. J. A. Stratton's report is indeed throughout concerned strictly with the teaching and research functions of the Institute, but in discussing them his awareness of the implications and opportunities of higher education to-day display an insight which should fittingly be matched here. For example, describing how the successful teaching of economics at the Institute since 1881, with the emergence of a major research programme and strong support of the School of Industrial Management, has now led to the establishment of sections of political science and of psychology within the Departments of Economics and Social Science, Dr. Stratton refers to the association of the former section with the Centre for International Studies. In support of this work a professorship in political science with emphasis on African studies was established, while a grant of 475,000 dollars from the Carnegie Corporation has permitted expansion of research on the problems of nation-building in transition countries and on the newly emerged African and Asian nations. Dr. Stratton stresses particularly the value of the grant in facilitating the sending of students from

the Institute overseas for research in developing areas.

Dr. Stratton's review this year directs particular attention to the state of the social sciences at the Institute, emphasizing the dependence of the overriding practical problems of to-day on joint technical and social analysis and the policy of the Institute to develop more particularly those social sciences which are specially relevant to its central concerns with science and engineering. Special attention has been focused on those fields in which mathematics and statistical techniques play an increasingly important part, but without attempting to build the social sciences in the image of the physical or limiting their freedom to develop in their own way, and in psychology marked progress was made in planning a graduate programme. The section will comprise three general areas: physiological and comparative; experimental; and social and developmental psychology; and in its research it is hoped to create new opportunities for interdisciplinary co-operation. A programme leading to a Ph.D. in linguistics is being offered beginning in the autumn of 1961 and much of the Institute's research in this field has taken place in the Centre for Communication Sciences, where besides a central concern with the structure and logic of language some promising applied projects, including work on mechanical translation and on machine perception and synthesis of human speech, have been undertaken.

The other main features of President Stratton's survey deal with the character of research at the Institute and its bearing on teaching, and with developments in undergraduate education, particularly in engineering. Discussing the first of those topics he refers again to the concept of interdisciplin-

* Report of the President, 1961. Massachusetts Institute of Technology, Cambridge, Mass. Pp. 64.