

Burkholder on some microbiological aspects of marine productivity in shallow waters. He pointed out that for the annual *Spartina* grass crop only 10 per cent of the dead material remained after being in water for 360 days. This means that microbiological decomposition is very active and that on such marshes relatively little organic matter accumulates.

The afternoon was devoted to field trips in groups around Sapelo Island. In the evening W. Hantzchel gave an account of the palaeontological significance of molluscan trails and burrows on tidal flats of the North Sea.

On the third day the salt marsh as an eco-system was debated. The discussion was introduced by A. C. Redfield, who gave an account of the movement of heat, salt and water in the soil of Barnstable Marsh, Mass. Analysis of the salt movements indicated that underlying fresh water was diffusing up and counteracting the downward movement of salt water, though this movement was not sufficient to affect the thermal waves. The next three papers were all concerned with productivity. L. R. Pomeroy gave an account of the diatom flora on Sapelo Island Marshes, A. E. Smalley showed that creekside *Spartina* grass on the Georgia marshes continued to grow after July whereas on the high marsh this was not the case, and J. M. Teal summarized the metabolism of the eco-system in the light of the information available. Although a number of gaps remain to be filled before a final, more accurate, calculation is possible, it seems that about 46 per cent of the energy utilized by the *Spartina* and algae is transformed and 54 per cent is lost.

The afternoon was devoted to a trip to Blackbeard Island to study the dune ridge system. In the evening A. C. Redfield gave an account of his work on Barnstable Marsh, Massachusetts.

On the fourth day the use of salt marshes for historical records was discussed. H. M. Raup and F. Johnson gave an account of the archaeology and salt marshes of Grassy Island in Massachusetts. E. S. Barghorn demonstrated how the Boylston Street peat at Boston and the peat of the Barnstable Marsh could be used both archaeologically and by radiocarbon dating to measure rate of marsh development in relation to land subsidence. The data indicate a mean subsidence-rate of about 6 in. per century for the past 5,500 years. J. R. Vallentyne discussed some aspects of the biochemistry of mud, particularly in respect of the breakdown of the chlorophyll pigments. The final contribution was by W. Schafer on elements of actuo-palaeontology in relation to beaches and shallow seas.

The afternoon was given over to various field trips and one group was flown over the marshes and mainland terraces in the plane belonging to the Woods Hole Oceanographic Institute. This also gave participants an appreciation of just how useful such a plane can be for coastal and oceanographic work. The meeting terminated with a dinner given by Mr. and Mrs. R. J. Reynolds, the owners of Sapelo Island. The University of Georgia is to be congratulated on initiating such a useful conference, which will undoubtedly bear results for a number of years to come.

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THE CARNEGIE INSTITUTION OF WASHINGTON

REPORT FOR 1956-57

THE Yearbook of the Carnegie Institution of Washington, covering the year July 1, 1956-June 30, 1957*, contains the report of the president and those of Departments and special studies as well as of the Executive Committee and of the auditors. The study of celestial objects as radio sources continued, both at the Mount Wilson and Palomar Observatories, and in the Department of Terrestrial Magnetism, where a programme of flux measurements on a few of the intense radio sources over a wide band of the useful spectrum has become an important project in radio-astronomy. Preliminary scans of the Sun's face made by an antenna array, specially designed for detailed examination of solar radio emission, have revealed localized light sources which move across the disk as the Sun rotates. Further investigation of radio noise from Jupiter indicates that there may be a single centre of activity on the planet with an approximately uniform rotational period, and the construction of a radio-telescope to be equipped with a 60-ft. dish has commenced.

At Mount Wilson spectroscopic observations were carried out with all major telescopes except the 48-in. Schmidt. The photoelectric scanning spectrograph was applied to the study of the energy distribution of the high-velocity giant Arcturus and of two

red giants in *M92*. A project on stellar composition and related nuclear processes at Mount Wilson and Palomar Observatories, sponsored by the Physics Division of the United States Air Force Office of Scientific Research, attempts to obtain new astronomical results relevant to theories of the origin of the elements, and to bring together a group of nuclear physicists and astrophysicists interested in aspects of this fundamental question. Photovisual observations of the Cepheids in the outer field of the Andromeda nebula, 96' south preceding the nucleus, were concluded and also the investigation of the variables in the Draco system. The main effort of the Committee on Image Tubes for Telescopes was directed towards the development of thin-film image converters.

Seismic and gravity studies continue to form an important part of the Department of Terrestrial Magnetism's work, and in co-operation with the United States National Committee for the International Geophysical Year the Department has undertaken a seismic study in the Andean highlands, using as indicators the explosions normally set off in the operation of large open-pit copper mines in southern Peru and northern Chile. Jointly with the Geophysical Laboratory, an investigation was commenced of regional regularities in the ages of the Precambrian rock exposures, which has already indicated that over much of Arizona, New Mexico, Colorado and Wyoming rocks were formed 1,300-1,400 million years ago and some in Ontario 2,600 million years ago. Concordant rubidium-

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strontium and potassium-argon datings have established an age of about 340 million years for the micas in a number of granitic rock samples collected from the Hercynian chain of western Europe, and it appears that either the Holmes time-scale of the lower Carboniferous, to which these rocks are usually assigned, is not correct or the accepted stratigraphic assignment of the formation requires revision.

Intensive studies at the Geophysical Laboratory of phase-equilibrium relations among the major mineral groups are making available a whole series of geological 'thermometers' which may be applied to igneous and metamorphic rocks, and similar types of 'thermometers' are being developed for ore minerals. In crystallography the Laboratory has demonstrated the first crystalline ultra-phosphate on record and, using an optical analogue, diffraction patterns similar in type to those obtained from X-ray studies of crystals have been produced. Investigations of simple methods of absolute counting of β -radioactivity were continued as well as studies in the production of various basalts, with particular reference to the possibility of obtaining them naturally by differentiation of a parental magma.

In the Geophysical Laboratory work has continued on the synthesis of amino-acids from simpler components under conditions simulating those believed to have obtained on Earth in remote geological periods, and glycine, alanine and serine, as well as more complicated substances, have been obtained by the action of ultra-violet light on an atmosphere of carbon monoxide, nitrogen and lesser amounts of hydrogen, water and carbon dioxide. Other work was concerned with the thermal degradation of amino-acids, while the biophysics group in the Department of Terrestrial Magnetism, concentrating attention on the organization of structure within the cell in terms of some framework larger than a protein molecule, has studied further the amino-acid pools in *Escherichia coli* and in yeast. Evidence was obtained that when the osmotic pressure of the medium is suddenly reduced, a flow of water occurs into the sensitive structures, together with a slow loss of solute from the cell, and that seleno-methionine can completely replace methionine and support exponential growth in a mutant of *E. coli* requiring methionine. It was also demonstrated that, under appropriate conditions, rather large particles containing nucleic acids, proteins and lipids can be made to form 'spontaneously' from disintegrated cellular material, and these particles have been named 'protomorphs'.

In the Department of Plant Biology attempts to isolate the naturally occurring protochlorophyll holochrome were continued, and corn mutants containing chlorophyll, both without and combined with phytol, have been found to form chlorophyll on illumination but to lose it rapidly on further exposure to light. During the year it was shown that large errors can be made in determining the peak position of the absorption bands of pigments occurring at high concentration in living cells, and investigation of the nature of these discrepancies has raised the question whether the double peak of chlorophyll absorption, observed by derivative spectrophotometry, is due to absorption by two actual components, or whether one of these presumed components may be an artefact due to the dependence of light-scattering on wave-length. The study of the growth of algae and their pigment formation in a crossed gradient of light intensity on one axis, and of temperature on the other, continued. Some progress has been made in the study of the comparative physiology of con-

trasting climatic races of the monkey flower, *Mimulus cardinalis*. Concurrently, genetic investigations and tests of growth responses at the altitudinal stations are being made to determine whether linkages exist between easily recognized morphological characters and the capacity of members of this group to survive at different altitudes. A comprehensive exploratory survey of the comparative growth and physiology of many species and races of Lemnaceae was completed, which disclosed striking differences in growth-rate among genera, species, and sometimes even strains of the same species at the same temperatures and light intensities. Relationships among the various forms of yarrow continued to be studied, and in the *Poa* investigations new results from searching tests involving forty-five apomictic hybrid lines of blue grasses being grown in a wide range of climates in the United States show patterns of performance that can be clearly related to the characteristics of the parental species. The selection of potentially useful agronomic forms of blue grasses has now been narrowed to less than ten.

The investigations of the Department of Embryology are no longer chiefly concerned with the human embryo, and important parts of its work are directed to the study of somatic cell variation in development and the elucidation of the mechanisms regulating differentiation at the chemical level. The report stresses the personal nature of such research. Among the investigations described are those into the metabolic implications of the predominance of retinene₂, the aldehyde of vitamin A₂ in the tadpole, and of retinene, the aldehyde of vitamin A₁, in the adult frog; and the demonstration, in investigations of spontaneous contractility, that in the chick embryo cultivated *in vitro* the addition of a tiny crystal of acetylcholine to the surface of the endoderm results in the formation of two independently beating hearts. Further investigation of the observation that injection into the male guinea pig of testicular extracts combined with adjuvant leads to the destruction of the spermatogenic elements in the testes of the recipient showed that sperm-immobilizing, sperm-agglutinating, and complement-fixing antibodies appear in the sera of the injected animals and not in the sera of animals injected with adjuvant alone. In further studies of the physiology of the placenta, standard procedures were devised for introducing a polyethylene catheter into the amniotic cavity or into the intervillous space or a uterine vein, and results have been obtained showing inherent amplitude-tonus patterns characteristic of individual uteri and of specific developmental periods in animals studied during a single pregnancy. A non-nutrient culture medium for amphibian embryonic tissues, a plastic-sheet method of three-dimensional reconstruction and an aid to the gentle dissociation and re-aggregation of tissue cells are among new techniques described.

The Department of Genetics continued the study of controlling elements in maize, particularly in a system of elements not related to the *Ds-Ac* system that control gene action at two known loci, and also the analysis of a structural modification in maize chromosome 9, one component of which exhibits strikingly aberrant behaviour in both somatic and germinal cells, initiating many different types of change in chromosome organization in somatic cells and inducing an unorthodox type of crossing over in meiotic cells. In analysis of organizational patterns of the hereditary materials in higher plants and animals, in which methods of enzymatic hydrolysis

were combined with modern techniques of electron microscopy, results obtained after deoxyribonuclease treatment of salivary-gland chromosomes of *Drosophila* fixed in osmium tetroxide and stained by the Feulgen method suggest that the main structural fibres are immune to nuclease or acid hydrolysis. New evidence has been obtained that the 'chromosome' of bacteriophage T2 contains nucleic acid exclusively and that it can multiply in functional form in bacterial cultures containing chloramphenicol. Further work on bacteriophages indicates that reverse mutations restoring the adsorptive capacity occur at the sites of the forward mutations from which they are derived.

Preliminary studies with stocks of the bacterium *Salmonella typhimurium* having various combinations

of genetic markers representative of a cystine locus and four tryptophan loci which are so clearly linked that they are carried forward in one transducing fragment have shown that these separate portions of a fragment may be incorporated simultaneously into a newly formed bacterial chromosome. Evidence has been obtained that a transducing fragment is not a randomly selected section of bacterial chromosome, and investigation of the process of haploidization with *Aspergillus* has shown that most haploids arise as a consequence of stepwise loss of one member of the various chromosome pairs. A survey of deoxyribonucleases located a better source of material in salmon testes, and procedures for its extraction and purification are being developed.

EUROPEAN BREWERY CONVENTION TRIALS

THE seventh report of the Barley Committee of the European Brewery Convention deals with the series of field trials carried out in 1956. This co-operative effort, in which thirteen West European countries participated, is the only one of its kind and provides an important precedent for similar work with other crop plants. In the report, comprehensive data collected from the trials are given for each country in which they were conducted. The grain was malted and the relevant analyses are listed. In addition, in Denmark, the malts were subjected to small-scale brewing tests.

It is interesting that grain yields, from the best varieties, were around two tons per acre, at one time considered an exceptionally high yield for the crop. Three varieties, Carlsberg II, Ingrid and Proctor, yielded consistently well in all countries, except for the last in Norway, whereas others, although doing well in some areas, were often poor elsewhere. This adaptability to, and tolerance of, a wide range of environments is an extremely valuable character and appears to come from a single genic source, since these three hybrids, although bred in different countries, Denmark, Sweden and England, respectively, are derived, on one side of their pedigree, from

common 'grandparents'. The report mentions that a sub-committee is studying the influence of climate on yield and quality, which should provide useful information on adaptability.

The outstanding feature of a dormancy assessment, made by comparing germinative energy with germinative capacity three weeks after harvest, was that under Norwegian conditions all varieties were extremely dormant except the locally bred Dømen. This variety did, in fact, show little or no dormancy in any trial. In no country was the grain quality exceptionally good because the nitrogen contents were high. It is apparent from the malt analyses that the varieties being studied differ from each other within a narrow range of variation. It is also apparent that the high-yield potential of the new varieties has not been obtained at the expense of grain quality; the two characters can be combined in one variety.

The "Descriptions of Barley Varieties" first published by the European Brewery Convention in 1954 is now undergoing revision. A new edition will be issued approximately every five years in order to include new varieties as they come into trial as well as additional information on established ones.

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SOCIAL BEHAVIOUR IN THE WILD RABBIT

By K. MYERS and R. MYKYTOWYCZ

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UNTIL now, practically all the available information on the social behaviour of the wild rabbit (*Oryctolagus cuniculus* (L.)) has been provided by Southern¹ from his study of a natural warren population near Oxford, carried out during the three years 1939-41. He described the dominance of "certain of the bucks" in the community and their behaviour in relation to their individual "spheres of influence"; he emphasized the "territorial conservatism" of the adult does in particular; and he explained that the social behaviour he observed would encourage polygyny, rather than promiscuity, in a rabbit colony.

As part of its ecological investigations on the rabbit, the Wildlife Survey Section of the Commonwealth Scientific and Industrial Research Organization has developed techniques for maintaining rabbits in enclosures, about 2 acres in area, so that they breed naturally, the individual history and behaviour can be recorded, and activity observed at night as well as during the hours of daylight. Recently, experimental populations were established in enclosures at Canberra and at Albury for studies that were originally unrelated and not primarily intended to be behavioural. These enclosures offered unparalleled opportunities, however, for studying the