thiophenes; and many new spectra of diatomic oxides, halides and diatomic ions which extend general theories of molecular structures further. H. C. Longuet-Higgins (Chemistry Laboratory, Cambridge) analysed theoretically the electron states of a composite system in relation to those of its constituent parts and showed how some general ideas about electron transfer configurations can be used in this connexion. R. S. Mulliken (University of Chicago) and C. J. Timmons (University of Nottingham) discussed charge transfer and charge resonance spectra and the correlation of spectra with intermolecular complex formation.

H. W. THOMPSON

PROGRESS IN RADIOBIOLOGY

CONFERENCE AT CAMBRIDGE

ON August 15, radiobiologists met in Cambridge for the third annual conference to discuss progress in their field. The three-day meeting, under the chairmanship of Sir Ernest Rock-Carling, was organized by Prof. J. S. Mitchell and his staff. Some 250 scientists, from sixteen countries including the U.S.S.R., enjoyed the hospitality of our Cambridge hosts. Eighty papers were discussed, the variety of the contributions reflecting the large number of disciplines on which an understanding of the biological effects of radiation must rest.

Biological lesions due to ionizing radiations must originate in the process of absorption of primary energy. Our current picture of the particle track, and relevant knowledge of the nature of the chemical intermediates, were presented by Prof. F. S. Dainton in an introductory lecture. A number of metabolic steps occur between the initial chemical disturbance and the appearance of damage in the organism, and some papers dealt with such effects. In the bacterium *Achromobacter fischeri*, the enzymatically controlled luminescence decreases during exposure to X-rays and recovers rapidly afterwards. Both decrease and increase follow an exponential time relationship (O. Hug and I. Wolf). Bacterial enzymes show a lower sensitivity to X-rays at low temperatures when exposed in the dry state or in solution, or when in the intact cell, suggesting some common physico-chemical mechanism of inactivation (H. Pauly and B. Rajewsky). It appears, however, that in the etiology of the opacity of rabbit lens caused by X-rays, biochemical changes in the lens are secondary to cellular damage in the dividing cells of the lens epithelium (A. Pirie).

The genetic effects of radiation took a prominent place in the discussions. Nucleic acids appear to be the main carriers of hereditary factors, and some insight into the action of radiations on genetic material may be expected from the study of radiation effects on them and their metabolism. Some questions discussed were the effect of ultra-violet light on ribonucleic acid metabolism in starfish oocytes (M. Errera and A. Ficq), the inhibition of deoxyribonucleic acid (DNA) synthesis by X-rays in the early stages of regeneration of rat liver (L. K. Mee), and the interesting results obtained in the irradiation of dry preparations of herring sperm deoxyribonucleic acid (P. A. Alexander and K. A. Stacey). The sensitivity of female germ cells of mice to the induction by X-rays of dominant lethal mutations is some seventy times greater at first meiotic metaphase than at a stage seven hours earlier (L. B. Russell and W. L. Russell). In *Habrobracon* eggs irradiated with ultra-violet light, damage to the nucleus is qualitatively and quantitatively different from cytoplasmic damage (R. C. von Borstel and H. Moser). A surprising result was obtained when a breeding population of *Drosophila* was exposed to 5·1 r. per hr. for about five years. Its genetic fitness was only 1–5 per cent lower than that of an unirradiated population, despite an accumulated dose of 250,000 r. (B. Wallace). We are not justified, however, in extrapolating from insects to mammals on the basis of these data (W. L. Russell). Bacteria and bacteriophage have been used as a simplified model for the study of genetic changes in populations (H. Marcovitch).

Since certain chemicals and X-rays cause similar biological damage, it is of interest to study the mechanisms by which these lesions arise. A whole-body dose of 100 r. of X-rays, or 1 mgm. per kgm. of nitrogen mustard, produce the same damage in rat lymph nodes; but the treatments have dissimilar actions since they are not interchangeable (C. Biagini). N,N-dichlorethyl-*p*-amino-phenyl-butyric acid causes mainly lymphoid, whereas 'Myleran' causes mainly myeloid effects in rat bone marrow. The effect of X-rays can be reproduced almost exactly by applying both chemicals at once, suggesting two separate physiological pathways for the developing X-ray damage (L. A. Elson, D. A. G. Galton, L. F. Lamerton and M. Till).

Factors influencing the radiosensitivity of biological systems were discussed in almost every session. It has been known for some time that radiation effects are usually greater in the presence than in the absence of free oxygen. Tails of young mice were used to demonstrate this with X- and neutron-irradiation (P. Howard-Flanders; E. A. Wright). The rapid autoxidation of cysteine in aqueous solutions suggests that a number of protective effects ascribed to this compound could be accounted for by anoxia (L. H. Gray). Cysteine and cysteamine have a stimulating effect on the oxygen consumption of liver slices. Their protective effect may therefore be due to a reduction in the amount of free oxygen in some organs (D. W. van Bekkum). Chemical protection and anoxia do not, however, always seem to act along identical pathways (R. W. Brauer, J. S. Krebs and R. Pessotti; J. Maisin, P. Maldagne, A. Dunjic and H. Maisin). Further, cysteine and cysteamine react with the sulphhydryl group of proteins and might thus protect the protein (L. Eldjarn and A. Pihl; R. Koch).

The effects of oxygen on radiosensitivity may be explained in terms of the relative efficiencies of oxidizing and reducing radicals in reacting with organic molecules, although the state of oxidation of the acceptor substances is of importance (A. J. Swallow; M. Ebert and A. Howard; H. Laser).

The radiosensitivity of barley seeds and of starch depends on humidity, and is at a minimum at 20 per cent. It was suggested that the cause is physico-chemical rather than physiological (L. Ehrenberg). The production of chromosome aberrations in *Vicia faba* roots by 8-ethoxycaffeine or X-rays is sensitive to oxygen, but adenosine triphosphate appears to be involved only in the case of the caffeine (B. A. Kihlman). Other work on *Vicia* indicates that inhibition of oxidative phosphorylation interferes with the rejoining of broken chromosomes (S. Wolff).

It is well established that shielding of hæmopoietic tissue, or implantation of such tissue after irradiation,

greatly improves the recovery of animals from acute radiation injury. It seems likely that the implanted cells are fully effective only if not destroyed by tissue antibodies (D. M. H. Barnes and J. F. Loutit). Spleen irradiated *in vitro* or taken from an irradiated donor can resume hæmopoiesis in the host even after a dose of 10,000 r. (E. H. Betz, G. Booz and J. Firket), and the spleen of an irradiated animal recovers more quickly if part of its bone marrow is shielded (E. H. Belcher, E. B. Harris and L. F. Lamerton).

The carcinogenic effect of a given dose of whole-body X-irradiation is approximately the same whether given in daily, weekly or fortnightly fractions, but is less effective when delivered in one exposure, as judged by the appearance of leukæmia in mice (R. H. Mole). Beta-radiation applied to the skin of rats produces more tumours when given in two exposures than in one (J. W. Boag and A. Glücksmann). Glass beads containing strontium-90 produce tumours at the site of implantation under the skin of rats, and the incidence of tumours is proportional to the logarithm of the radioactivity (G. Schubert, H. A. Künkel and G. Uhlmann). Rats of a tumour-free strain, protected by cysteamine or part-shielding against the acute effects of X-irradiation, develop a variety of tumours if they survive more than six months (Maisin *et al.*). Therapeutic irradiation for ankylosing spondylitis appears to be followed by a five- to ten-fold increase in the rate of deaths from leukæmia (W. M. Court-Brown).

For those who attended the previous conferences (Aarhus, 1953, Liège, 1954), several points of increased emphasis became apparent at this meeting. They included more widely based inquiries into the mechanism of action of protective agents, the long-term carcinogenic effects of radiation, and the search for biochemical links in the developing radiation-induced lesion.

M. Ebert
A. Howard

NEW NATURE RESERVES IN GREAT BRITAIN

THE Nature Conservancy has announced the establishment of five new nature reserves, three in England and two in Scotland, as follows: Roudsea Wood, Lancashire (ten miles west of Grange-over-Sands); Wybunbury Moss, Cheshire (three and a half miles south of Crewe); North Fen, Lancashire (two miles west of Windermere); Hermaness, Unst, Shetland; and Noss, Shetland. The Conservancy has also announced the addition of areas to the following two existing reserves: Castor Hanglands, Northants (four and a half miles north-west of Peterborough); and Kingley Vale, Sussex (four miles north-west of Chichester).

Roudsea Wood is one of the most varied woodlands in the British Isles, with a rich flora and fauna and many different types of vegetation. It lies in the south of the Lake District and is the first nature reserve to be declared within an English national park. The reserve, which has been formed by agreement with the owner, Mr. R. E. O. Cavendish, covers an area of 287 acres and is about ten miles west of the Conservancy's Research Station at Merlewood, Grange-over-Sands, Lancashire. The main part of the wood consists of two parallel ridges, one of limestone and one of slate. The limestone ridge is crowned by a yew wood and has interesting mixtures of oak and ash on its flanks with a luxuriant ground flora, including lilies-of-the-valley. The slate ridge, on the other hand, is a typical Lake District slate oak-wood which has, in part, been coppiced for charcoal production. Between ridges there is a small tarn, now nearly filled, and around it an abundance of fen plants and fen insects. Among these is a sedge (*Carex flava*) for which this is the only British locality. There are a wealth of sloe, alder, birch and other shrubs, and a correspondingly great variety of insect and bird life.

On its seaward side, Roudsea Wood slopes down into the Morecambe Bay salt-marshes, this being one of the few places where the transition from salt-marsh to woodland can be studied. On the landward side lie the Holker mosses, and the transition from the vegetation of peat to that of limestone and slate is also of very great biological interest. In addition to the usual plants and insects, there are roe-deer, occasional fallow and red deer, and a great variety of wild-life of every kind. One of the main objects of this reserve is to serve as an undisturbed outdoor laboratory for the scientific workers at Merlewood, who have already begun their investigations, and applications for permits to visit the reserve for research or collecting purposes should be made to the Conservancy's regional officer at Merlewood.

Wybunbury Moss in South Cheshire is an unusually large example of a 'Schwingmoor', a type of bog not before described in Britain. It has been formed in a steep-sided kettle-hole in sandy, glacial material, the sides of which are cultivated and used for grazing. Only part of the land has been declared a reserve, and it is hoped to extend the area in the future. At the centre of the bog there is only a thin crust of sphagnum peat 6–10 ft. deep floating on water, but at the margin deposits of both sphagnum and fen peat have accumulated to form a solid organic layer over the glacial sand. The surface vegetation shows a surprising variety for such a small area. The margins, which must receive a mineral supply from the cultivated sides of the kettle-hole, carry a fen community with sedges such as *Carex paniculata*, but this fen is a secondary development because it is underlain everywhere by sphagnum peat. As a marked contrast, the central area shows a typical bog flora carpeted with sphagnum species in which cross-leaved heath (*Erica tetralix*), cranberry (*Oxycoccus palustris*) and marsh andromeda (*Andromeda polifolia*) are common. The ground is gradually becoming drier as part of the natural development, and, as this occurs, trees, mainly birch and scots pine, are spreading. The reserve will be used solely for scientific research, and permission to visit it can only be obtained through the Conservancy's officer at Merlewood.

The main interest of North Fen is that it shows the vegetational succession characteristic of the climatic conditions found in north-western England—open water, rich in mineral salts, to fen-carr and bog. It is mainly woodland and is only just beginning to show signs of sphagnum bog development, in contrast to the nearby Blelham Bog reserve, where there is very little left of the original woodland. The reserve lies on the north side of Esthwaite Water in the Lake District National Park and is being established under a lease from the National Trust. The vegetational succession in North Fen is reedswamp (*Phragmites communis* dominant, with *Scirpus lacustris* on the offshore margin), mixed fen (predominantly a sedge association with *Carex elata* and *Carex rostrata* conspicuous), open carr followed by closed carr (dominated by *Salix atrocinerea*). Some modification of this succession occurs, particularly on the western