stitial tumours were found, locally invasive and of multiple origin. No metastases were seen. For the period of exposure, up to 48 months, the lung was the critical organ causing death.

An original technique for the safe radiological visualization of the human lung was due to G. V. Taplin *et al.* (University of California).

Serum radioalbumin in a 1 per cent solution is readily aggregated by adjustment of *p*H and heating at 79° for 20 min. 10–20 mμ particles act like bacteria and are removed by the liver on first passage. By lowering the *p*H macro aggregates of 5–50μ are formed. These are too large to pass through the capillaries of the lung, where they are temporarily trapped for 1–2 h. The lung can be scanned photographically during this period, and on the resulting picture it is possible to detect pulmonary emboli, lung infarcts, pneumonia, atelectasis, certain tumours and cysts causing local ischæmia.

Work at the U.S. Public Health Service (Taft Laboratories, Cincinnati) on the intake of radiostrontium by infants was presented by B. Kahn *et al.* Levels in air, water and prepackaged baby foods were measured and the ingestion calculated. Retention was deduced by subtracting the activity in the excreta; strontium-89 and -90 are present in air in soluble forms.

The last papers read dealt with the removal of inhaled radioactive materials. I. Schmidtke (University Clinic, Freiburg-im-Breisgau) treated guinea pigs with diethylene triamine penta acetic acid after exposure to $^{91}YCl_3$ aerosol. A 95 per cent diminution of retention was found, in comparison with untreated animals, after 8 days. The action was mainly on the kidneys, and most of the activity was recovered from the urine. E. G. Tombropolous (Hanford Laboratories) considered that chelating agents were the most effective means, when applicable, of removing radioactive particles from the lungs. Drugs which decrease mucus secretion or increase phagocytosis are also worth testing. F. Gensicke and H. W. Nitschke (German Academy of Sciences, Berlin-Buch, G.D.R.) reported that sodium hexametaphosphate had a scavenging effect on inhaled yttrium-91 in mice.

Papers read in title dealt with a spinning disk atomizer, a routine technique for estimating plutonium in large biological specimens, fall-out from burnt-up uranium and plutonium, Zr–^{95}Nb in human lungs from medium life fission products in the atmosphere, atmospheric analysis for total β-activity and the monitoring of human subjects who had accidentally inhaled fission products.

The papers will be published in full in the December 1964 issue of *Health Physics*. C. N. Davies

BIOSYNTHETIC PATHWAYS IN HIGHER PLANTS

THE biosynthetic pathways leading to all the major groups of compounds present in higher plant tissues were discussed at the seventh annual general meeting of the Plant Phenolics Group which was held at Bodington Hall, University of Leeds, during April 13–15. The wide range of topics covered by the symposium coincided with a decision by members to change the name of the Group to the Phytochemical Group with the view of promoting the advancement of the chemistry, biochemistry and related sciences of all plant products.

The opening address was given by Prof. N. A. Burges (University of Liverpool), who discussed the biological aspects of biochemical reactions and the possible differences between reactions *in vivo* and *in vitro*. This is an important consideration which is still sometimes overlooked by chemists. Biochemical reactions *in vivo* are commonly studied by feeding in potential precursors labelled with 'heavy' or radioactive isotopes. Dr. T. Swain (Low Temperature Research Station, Cambridge) gave a critical account of these methods. In particular he noted that feeding experiments often led to an understanding of the starting and end points of a pathway but gave little information regarding the individual steps and the control mechanisms. He emphasized the need for investigating the enzymes which catalyse each step, and he brought to the attention of the meeting other conditions, such as environmental and genetical factors, which could affect biosynthesis.

The first paper on a particular group of plant constituents was presented by Prof. T. W. Goodwin (University of Aberystwyth), who gave an account of the formation of terpenoids, compounds which appear to play a key part in chloroplast development. When etiolated seedlings are illuminated there is a massive synthesis of terpenoids as the functional chloroplasts are produced. During the greening period, carbon dioxide but not mevalonate is incorporated into the chloroplast terpenoids, but the reverse is true for the related sterols which are also present. It is believed that the biosynthesis of terpenoids in developing seedlings is regulated by enzyme segregation and specific membrane permeability. A second paper concerning the detailed steps involved in the elaboration of carotenoids, starting from acetate, was also presented by Prof. Goodwin.

An account of the amino-acids found in plants was given by Dr. L. Fowden (University College, London). In his lecture he concentrated on the large number of non-proteinogenic derivatives of which at least two groups are recognized. First, those which are intermediates in the formation of the twenty protein amino-acids and also those which arise by the non-specific action of enzymes normally associated with the metabolism of the proteinogenic compounds. The role of most of them is unknown.

Studies with micro-organisms have provided evidence that DNA controls the synthesis of proteins. This evidence was reviewed together with the mechanism of amino-acid polymerization by Dr. D. Boulter (University of Liverpool). He also described the similar findings made with higher plants and commented on the work being carried out at the University of Liverpool on protein synthesis in developing seeds.

The vast field of carbohydrate biochemistry was also reviewed (Dr. J. S. D. Bacon, Macaulay Institute, Aberdeen) mainly with reference to simple sugar phosphates and the more complex nucleotides derived from them. The synthesis of insoluble polymeric carbohydrates still remains something of a mystery. For example, although cellulose is the most abundant plant polysaccharide, we know very little about the formation of this material. Recent investigations by Hassid *et al.*[1] at Berkeley have implicated guanosine diphosphate glucose, and Prof. R. D. Preston (University of Leeds) was able to tell the Group of other interesting observations, of a biophysical nature, which help in the general understanding of this problem. He discussed the arrangement of cellulose microfibrils in the cell-walls of seaweeds and showed electron micrographs of spherical granules which are apparently involved in the synthesis and orientation of the polymer strands.

An equally complex problem, which was summarized by Dr. F. A. Isherwood (Low Temperature Research Station, Cambridge), is the structure and biogenesis of lignin. Progress in this field has slowed down considerably during the past few years and the molecule still refuses to give up all its secrets. There is little doubt, however, that the aromatic rings in this polyphenol are derived from shikimic acid and it is probable that the

$C_6 : C_3$ units, of which it is composed, are condensed together in a random fashion. The development of methods for determining the sequence of these units in the polymer is, therefore, awaited with great interest. The shikimic acid pathway is also utilized by plants for the formation of flavonoids. Prof. H. Grisebach (University of Freiburg) described recent theories regarding the synthesis of these pigments. These involve the condensation of cinnamic acids with malonyl-CoA, but so far the formation of the necessary activated cinnamic acids has not been demonstrated using plant enzymes.

The early stages of hæm and chlorophyll biosynthesis follow a common pathway and this has been deduced mainly by investigations with preparations from animal tissues and photosynthetic bacteria. Dr. J. Lascelles (University of Oxford) outlined this chain of reactions and gave an account of the interesting investigations which are in progress, using *Chlorella* mutants and photosynthetic bacteria, on the final stages in chlorophyll synthesis.

The final paper in the symposium, by Prof. S. L. Ranson (University of Newcastle), was concerned with the formation of aliphatic carboxylic acids by plants. Some of these, such as malate, citrate and oxalate, commonly accumulate to a relatively high concentration in the cell. Others, such as fumarate and aconitate, accumulate infrequently. Why some cells accumulate one acid and others a different acid is a problem which remains to be settled.

The Group is indebted to the University of Leeds for the facilities which were placed at its disposal at Bodington Hall. Profs. F. C. Happold, I. Manton and R. D. Preston, all from the University, kindly acted as chairmen during three of the symposium sessions. J. B. Pridham

[1] Elbein, E. D., Barber, G. A., and Hassid, W. Z., *J. Amer. Chem. Soc.*, **86**, 309 (1964).

UNUSUAL FORMS AND ASPECTS OF CANCER IN MAN

EITHER too much or too little tends to be made of the rarities in medicine: purely chance phenomena are described *in extenso*, whereas sight is lost of significant observations in the flood of scientific literature. The conference held by the New York Academy of Sciences on "Unusual Forms and Aspects of Cancer in Man", in October 1963 (ref. 1), was an attempt to assess the importance of certain cancer rarities by grouping them together and discussing them in open forum. Many of the data and views presented at the conference had previously been put forward elsewhere. However, earlier communications were scattered through a variety of journals and several were not widely known. The publication of the proceedings of the conference therefore constitutes a valuable addition to the medical literature.

The comparative value of different types of cancer treatment can be assessed relatively simply, but it is less easy to assess the value of treatment *per se* during an era in which almost every case receives some form of therapy. From his survey of 250 female cases of untreated breast cancer included in the 1805–1933 records of the Middlesex Hospital Charity, Bloom[2] comes to essentially the same conclusions as Doland[3], Greenwood[4] and Nathanson and Welch[5]. He records a mean survival period of $3\frac{1}{4}$ years from the onset of symptoms, with almost 20 per cent of patients surviving for 5 years and 3 per cent for 10 years. Bloom is satisfied that all generally accepted methods of treatment both prolong life and reduce suffering from the effects of the disease. On the other hand, it appears that no measurable improvement in the results of treatment of breast cancer has occurred during the past few decades[6]. The possible value of radiography in the detection of early breast cancer has been under investigation for more than thirty years, but, mainly because of failures in techniques, it has not found general favour. It is now clear that, in the hands of the expert, mammography sometimes results in the detection of breast cancer before a positive diagnosis could be made clinically by inspection and palpation[6,7]. Nevertheless, in the opinion of Egan[6] it is too early to opine whether biannual mammography should be used to screen the female population for early breast cancer.

In an age of nuclear weapons, the carcinogenic effect of ionizing radiation is a political issue. It has therefore achieved more prominence than is justified by the facts. Investigations on the survivors of Hiroshima and Nagasaki[8] revealed the expected excesses of myeloid leukæmia[9] and thyroid cancer[10]. In addition, an excess of anæmia due to myelofibrosis has been observed. Many of the thyroid cancers were microscopic and did not contribute to the death of the victim. Moreover, the incidence of small foci of thyroid cancer has not been adequately investigated in comparable unirradiated populations. This raises another problem. One is apt to assume that there is little scope these days for changes in standards of diagnosis. In fact, attempts at earlier diagnosis[6,7], increasing autopsy rates, the classification of microscopic lesions as cancer[8,11,12], and a gathering interest in aged patients[13] are steadily altering the background against which other more closely investigated events are studied.

It is generally held that the majority of lung cancers arise in the large bronchi within a few inches of the bifurcation of the trachea. It is within the same areas that the particulate matter present in inhaled tobacco smoke and polluted air tends to be deposited[14]. Rigler presents a survey of patients in whom routine chest roentgenograms were taken at intervals prior to the diagnosis of lung cancer. The first radiological signs were usually present almost a year before the onset of significant symptoms. In some cases the interval between the first sign and the making of a definitive diagnosis was as long as 5–10 years. The finding that the majority of tumours arose in the lung periphery and were not symptomatic until they had spread centrally is surprising, since it suggests that the deposition of particulate matter is not closely related to cancer induction. One wonders how often centrally arising tumours would have been detected radiologically in their early stages, and to what extent Rigler's conclusions are influenced by the fact that they are based on selected material.

Successful treatment of cancer discovered during pregnancy may involve the loss of the fœtus. Most would regard this loss as an unfortunate necessity, but whether the discovery of cancer *per se* provides grounds for the deliberate termination of pregnancy is another matter. Rarely, cancer cells cross the placental barrier and grow metastatically in the fœtus[15,16]. The demonstration of so-called vertical transmission of murine leukæmia viruses[17,18] prompts the search for examples of similar transmission of tumour viruses in man. However, as yet no human tumour viruses have been positively identified. A few forms of cancer have an undoubted familial tendency. It is exceptionally rare for one of these types of cancer to be diagnosed for the first time during pregnancy. Cancer during childhood is rare, and the occurrence of two cases in one family suggests a transmitted genetic or viral factor. Dargeon[15] records six examples of malignant disease arising in two children of the same family: in no case was it possible to say whether these arose as the result of coincidence, transmission of a genetic