intensive production, provided that suitable nutrition and other environmental conditions are applied. Dr. Hammond showed by diagrams how a system of priorities operates whereby nutrition is supplied from the blood stream for the various body tissues and how the animal adjusts itself to the nutritional requirements. A balance is obtained according to the needs of the different tissues and the extent to which they are developed in the make-up of the animal; in cows in which high milk yields are being developed, the requirements for udder development are greater than those in the poorer milk yielders. He also dealt with pigs, in which he showed that, after feeding at a high nutritional level, better growth and development results if the high level is maintained.

Sir Thomas Dalling, chief veterinary officer, Ministry of Agriculture and Fisheries, took as his subject "Relationship of Animal Health to Production". He pointed out that in the absence of a healthy animal the results of attempted improvement in production may fail. He pleaded for a better understanding of the physiology of some of the important systems in the animal body, the study of which has been long neglected but is now being taken up largely through the efforts of the Agricultural Research Council. Infectious diseases must always limit increased production, and therefore a better understanding of their nature and how they spread is necessary; much attention has been given to their control throughout the world, and measures are being successfully practised. Sir Thomas referred at some length to bovine tuberculosis and the limits its presence in cattle places upon production. Research work has resulted in the application of schemes for its control, and eradication from Great Britain is now being undertaken. Venereally transmitted diseases and the value of artificial insemination in their control were also referred to. Dealing with increased yields of milk, special attention must be given to the health of the udder and the prevention of mastitis. In addition to the knowledge that certain micro-organisms play a part in the causation of mastitis, Sir Thomas referred to the necessity for adopting satisfactory husbandry and hygiene procedures to prevent injury to the udder tissues. He mentioned the necessity for regard for the health of an animal from the time it is conceived and throughout its young life; he stressed the importance of feeding colostrum to the newly-born animal. His remarks also covered the health of pigs and the need for close attention to nutrition whereby a sudden change in the bacterial flora of the digestive tract may be prevented. He gave as an example the finding of large numbers of micro-organisms of the salmonella group in the intestine, following the use of unsuitable diets. Sheep and poultry were also dealt with—the susceptibility of the former to infections with anaerobic micro-organisms, especially when in a thriving condition, and the high incidence of disease in the latter associated with high egg production.

Dr. A. S. Parkes, National Institute for Medical Research, discussed the "Preservation of Spermatozoa at Low Temperature". He showed a film which illustrated the freezing and thawing of red blood cells and spermatozoa in the presence of 15 per cent glycerol, the thawed cells being unimpaired. In the absence of glycerol the spermatozoa do not resume motility. Fowl spermatozoa so treated have been shown to retain their fertilizing capacity. Dr. Parkes thought that, with further refinements of technique, it would be only a matter of time before semen from bulls and other animals could be kept in a frozen condition and used long after it was obtained from the animal: in fact, he foresaw that an animal would be used as a sire long after its death. The results of this work have an important practical application. In artificial insemination as a method of breeding there is a heavy loss of semen, for it is not always possible to adjust supply to demand. When Dr. Parkes and his colleagues have progressed further in their studies, it is to be hoped that they will be able to show that semen from livestock can be preserved with results similar to those they have obtained in poultry; this will be an important forward step in improving livestock production by the greater use of selected sires.

## ADVISORY COUNCIL FOR SCIENTIFIC POLICY

THE fourth annual report of the Advisory Council on Scientific Policy* covers the period April 1950–March 1951 and, apart from the discussion of the implications of the Colombo Plan for the employment of scientific workers, technologists and other experts from Great Britain and of the recommendations of the Committee on Toxic Substances in Consumer Goods, which occupy the greater part of the report, covers much the same ground as the third report. In regard to scientific man-power the report notes that the rearmament programme will make particularly heavy demands for physicists, chemists and engineers. The Advisory Council admits that the views expressed in its last report regarding the supply of scientific men under-estimate the difficulty and that over a wide field the demand exceeds the available supply. It has set up a standing Committee on Scientific Man-power, on which the Ministry of Labour and National Service and the University Grants Committee are represented, to deal with the position. The membership of this and of other standing committees set up by the Advisory Council is detailed in an appendix. A particular question of scientific man-power, that relating to biologists, has been remitted to another of these committees, that on Biology and Allied Sciences, and this committee reported that while more general botanists and zoologists than can find employment as such may be graduating, there is a continuing shortage of most kinds of biological specialists, particularly of those suitable for employment by the Agricultural and Medical Research Councils and for posts overseas. It is unlikely that this shortage will be made good for several years, and it may be accentuated if the plans for economic development of under-developed areas, whether under the Colombo Plan or in other parts of the world, come to fruition and the biological work of the Colonial Service increases.

The Advisory Council recognizes the great scope for expansion of Colonial research, and that such expansion is likely to be limited by a shortage of scientific workers trained in the necessary disciplines as well as by financial stringency. It is equally concerned that the demands which the numerous agencies concerned with the development of backward areas may make upon British resources of scientific man-power cannot be met, if all the plans discussed come to fruition, without serious damage to other

* Fourth Annual Report of the Advisory Council on Scientific Policy (1950–1951). Pp. 18. (London: H.M. Stationery Office, 1951.) 9*d*. net.

commitments. It emphasizes that the situation will only become more difficult if suitable undergraduates are now deterred from taking up careers in one of those fields of biology in which there continues to be an unsatisfied demand. It suggests that, where requests for scientific assistance under the Colombo Plan are referred to the United Kingdom, they should be examined, where appropriate, by the Research Councils, to see whether they could be fitted into their current programme of work, and that the men sent abroad should retain a connexion with one of the research councils or some other research organization at home so as to prevent isolation impairing the value of their work. Moreover, although facilities for training in British universities and other institutions are severely taxed and the financial provision may be curtailed, the Advisory Council thinks it important that places should be found for people sent to Great Britain under the Colombo Plan. In this way we could play an important part in the development of South and South-East Asia, and the effect of such assistance would be to cement and strengthen the relations already existing between the United Kingdom and the under-developed countries.

The Advisory Council's discussions on the Colombo Plan brought out three further points which are relevant to any major schemes of development in under-developed territories. First, experience has shown the value of initiating pilot schemes in the first instance, rather than full-scale work. Second, it emphasizes the importance of a historical study of the sociological and ecological effects of similar economic developments in the past, and of attempting to apply sound sociological principles simultaneously with promoting economic development. Third, although the extensive application of science could greatly improve the economic standards of these countries, so long as the population of the world continues to increase at its present rate the hoped-for improvements in the standards of life may not, in fact, occur.

On higher technological education, the present report adds very little to what was contained in last year's report. It notes that the proposal in the report of the National Advisory Council on Education for Industry and Commerce for a "Royal College of Technologists" does not meet the need for an expansion of the facilities for higher technological education. The Advisory Council reiterates the view that expansion of these facilities is essential if we are to develop a balanced supply of applied scientists of adequate calibre and training to achieve the broader and more vigorous applications of scientific methods and advances upon which our industrial prosperity so closely depends. While it rightly points out that the necessary development of technological education is a long-term process which must take more than a decade to achieve, something more might well have been expected of the Advisory Council in this important matter than a hope that an early decision will be announced.

The Advisory Council has received from its Scientific Library and Technical Information Committee a report on the needs of the national library of science and invention which is to form part of the new Science Centre in London. It is understood that the President of the Board of Trade has agreed that the Patent Office Library should be expanded to form the national reference library of science and invention, and that it will continue to serve the needs of the Patent Office. The library will cover the whole field of science and will be supported by the specialized libraries of the learned societies. The areas of its responsibility have been agreed with the Agricultural and Medical Research Councils and with the government departments principally concerned. A novel feature of the library is that it is not proposed that it should contain any scientific literature more than about fifty years old. In conformity with this plan, material which has ceased to have value for current work will be pruned in consultation with the British Museum. The library will serve working scientific men in industry and all those concerned with research and development; but it will not provide for other users, such as undergraduate students, for whom other facilities exist. The Committee's report has been approved by the Lord President of the Council and it has been passed to the Ministry of Works for preliminary planning in connexion with the Science Centre.

The Panel on Technical Information Services has now been dissolved and its responsibilities have passed to the Scientific Library and Technical Information Committee, which is now examining the recommendations in the Panel's report on technical information services in the United Kingdom. This report has since been published in the *Journal of Documentation* (June 1951).

The Advisory Council has considered the comments of the Medical Research Council and of the government departments concerned on the recommendations of the Committee on Toxic Substances in Consumer Goods. While it believes that the risk to life and health is probably small, the rapid growth of the chemical industry and needs of the food-processing industries for substitutes to replace scarce materials or for new chemicals for improving the appearance, palatability or texture of manufactured foods are accelerating the pace at which new chemical substances are being introduced into consumer products, and existing machinery for testing the possible harmful effects of these substances is inadequate. Adequate and fully effective arrangements should therefore be made by government departments for the acquisition of information about possibly noxious substances or processes which industry may contemplate using, before these are allowed to find their way into the composition or treatment of the articles concerned; but the Advisory Council agrees with the view that new legislation is not required at present, and recommends that manufacturers should be informed that they are expected to take all reasonable care to ensure that no new substances should be offered for sale if toxic effects are suspected. It also recommends the establishment of a standing committee of representatives of the departments mainly concerned, and that the Medical Research Council should retain the general responsibility of keeping the whole problem under review and of initiating research and should receive adequate financial provision for the purpose, including the development of information services. Information over the whole field of toxic substances should be interchanged with the appropriate authorities in other countries, and particularly with the Food and Drug Administration and other government agencies in the United States. The Advisory Council also thinks that it would be appropriate for the cost of a central toxicological laboratory to be borne by industry, either through subscriptions or out of fees paid by trade associations.

A Committee on Atomic Energy considered the possible industrial uses of atomic energy and their

economic value. In the view of this Committee, there is a reasonable prospect that atomic power can be developed on a large scale and that the cost would not ultimately differ widely from that of coal. Successful development of an experimental atomic power plant depends largely on metallurgical development which is now proceeding, and the capital cost of an early type of atomic power station would be substantially greater than that of a coal station, although its fuel costs might be less. Development of such stations to a point when they can contribute substantially to the power resources of the country is likely to take at least a generation, and the Advisory Council emphasizes that work on the civil applications of atomic energy should not be allowed to retard inquiries into the better utilization of existing sources of heat and power.

# BIOPHYSICAL STUDIES OF RHEUMATOID CONNECTIVE TISSUE

By Dr. J. H. KELLGREN and Dr. J. BALL

Rheumatism Research Centre, The Royal Infirmary, Manchester

AND

Prof. W. T. ASTBURY, F.R.S., Dr. R. REED and E. BEIGHTON

Department of Biomolecular Structure, University of Leeds

## Introductory

In rheumatoid arthritis and related syndromes, characteristic changes may be found in the connective tissue for which the term 'fibrinoid' is usually employed. This fibrinoid change occurs in minute spots scattered sparsely throughout the affected tissues; but on the elbows and elsewhere, sizeable aggregates may form which with their surrounding zones of fibrous and inflammatory tissue constitute the classical rheumatoid subcutaneous nodules.

Fibrinoid areas can often be seen with the naked eye as yellowish opaque spots in the semi-translucent connective tissue; but they can be recognized with certainty only by histological examination, when they are distinguished by the following characteristics.

Within a fibrinoid area connective tissue cells are either few or absent altogether, and the regular fibre pattern of normal connective tissue is replaced by a disorderly mesh of swollen, indistinct bundles or clumps of amorphous material. With eosin the fibrinoid area stains a more intense red than the surrounding connective tissue. Deposits of fibrin in the tissues may give rise to a somewhat similar appearance, hence the term 'fibrinoid'.

In frozen sections stained by Lillie's reticulin method and Van Gieson's stain, a fibrinoid area may show three different effects: fine silver-staining fibrils which histologists call reticulin; occasional clumps of material staining reddish-brown like normal collagen; and an indistinct refractile material which takes a yellow colour with the Van Gieson stain. In sections treated by the periodic acid – Schiff technique, the fibrinoid areas stain more strongly than normal connective tissue with the pink or magenta colour which is considered by many histologists to indicate the presence of polysaccharides. Histological evidence, therefore, suggests that a fibrinoid focus is not necessarily homogeneous but corresponds to alterations in both the collagen and polysaccharides of connective tissue.

It would be a substantial advance if these histological appearances could be correlated directly with observations at or near the molecular level, and the purpose of this communication is to present a preliminary account of such a comparison with the findings of X-ray diffraction and electron microscopy.

## Methods

Owing to the random distribution and minute size of most fibrinoid lesions, the first requirement was an accurate sampling technique. To this end we obtained biopsy specimens of recently formed subcutaneous nodules from patients with active rheumatoid arthritis, and each specimen was fixed in 5 per cent formol saline and trimmed to a firm rectangular block which was then embedded in ice and cut in such a way that $10\,\mu$–$15\,\mu$ sections immediately preceded and followed a slice 1 mm. thick. The sections preceding and following the slice were stained in various ways and examined under the optical microscope, and, if they showed suitable areas of histologically well-defined fibrinoid, photomicrographs ($\times$ 8) were made. The corresponding thick slice was then washed in water and enclosed (wet) in a carrier specially adapted to the needs of a point-by-point

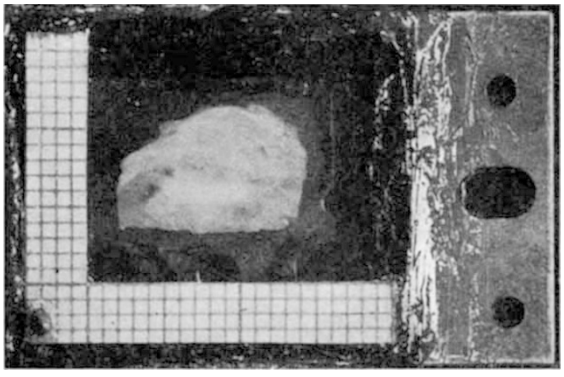

Fig. 1*a*. Slice of rheumatoid subcutaneous nodule mounted in carrier for exploration by X-ray diffraction

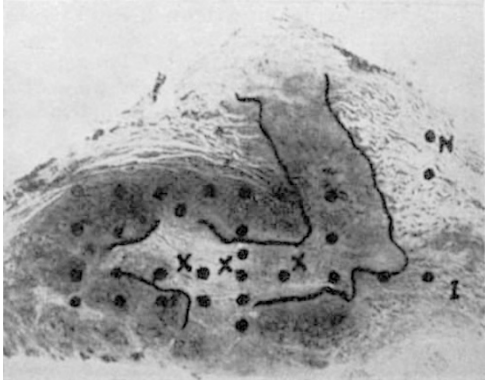


Fig. 1*b*. Photomicrograph of immediately adjacent section showing topographical relation between histological and X-ray examination. *N*, probably normal collagen; *I*, incipient abnormality; *X*, fibrinoid sites common to slice and adjacent sections. ●, sites of X-ray photographs