5

REPORT OF THE MEDICAL RESEARCH COUNCIL OCTOBER 1963—MARCH 1965

Presented to Parliament by the Secretary of State for Education and Science
by Command of Her Majesty
October 1965

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* Lord Amory succeeded Lord Shawcross as Chairman of the Council in October 1965.

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(91794) A 2

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CONTENTS

(91794) A 3

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* See p. 288 for Subject Index.

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PAGE

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REPORT OF THE MEDICAL RESEARCH COUNCIL 1 OCTOBER 1963 TO 31 MARCH 1965

To the Secretary of State for Education and Science

The Medical Research Council submit the following report on their proceedings during the period from 1 October 1963 to 31 March 1965. This extension of the usual twelve-month period arises out of the requirement of the recent Science and Technology Act that the reports of the Research Councils should span the financial rather than the academic year.

Following their normal custom the Council add to this report a series of articles on selected aspects of medical research and summaries of the work of their research establishments and of other projects they have supported during the period under review. A more complete picture of the work supported by the Council may be obtained from the large number of publications in the medical and scientific journals by members of their scientific staff and by the staff of other institutions receiving assistance from the Council. Lists of these publications are too long to be included in the Annual Report but they are available on request from the Librarian of the National Institute for Medical Research.

CONSTITUTIONAL POSITION OF THE COUNCIL

As a result of the Science and Technology Act, the Committee of Privy Council for Medical Research has been disbanded. This Committee derived from a most useful formula that had its origin in the famous report of the Haldane Committee on the Machinery of Government; through the Committee of Privy Council the Medical Research Council (and their counterparts in other fields) were provided with a constitutional link with Government and enabled to pursue a policy for the advancement of scientific knowledge independent of departmental limitations. In practice it has been the Chairman of the Committee of Privy Council—for many years the Lord President of the Council, more recently the Minister for Science and latterly the Secretary of State for Education and Science—who has provided the link by serving as the Minister responsible to Parliament for the Medical Research Council's work. The Science and Technology Act leaves this position practically unchanged.

SCIENTIFIC PROGRAMME AND POLICY

REVIEWS OF THE COUNCIL'S FIELD OF RESPONSIBILITY

It is the custom of the Council to consider a particular aspect of medical or biological research or some allied subject at the ' noon session ' of their monthly meetings; in this way they are able to keep their field of interest under review,

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and to examine the changing needs and opportunities of research. Over the period of this report the subjects covered and the experts who spoke to the Council were as follows:

1963		
October:	Perspectives in virology	Professor M. G. P. Stoker (*Honorary Director, Experimental Virus Research Unit*)
November:	Research programme of the World Health Organization	Dr. M. G. Candau (*Director-General, World Health Organization*)
1964		
January:	Medical research in the USA	Dr. J. A. Shannon (*Director, US National Institutes of Health*)
February:	Developments in toxicology	Dr. J. M. Barnes (*Director, Toxicology Research Unit*)
March:	Social research and the interests of the Medical Research Council	Professor D. V. Glass (*Professor of Sociology, London School of Economics and Political Science*)
April:	Cancer research	Professor A. Haddow (*Director, Chester Beatty Research Institute, Institute of Cancer Research*)
May:	Medical research from the university viewpoint	Sir Robert Aitken (*Vice-Chancellor, University of Birmingham*)
November:	Biological standardization	Dr. D. R. Bangham (*Head of Division of Biological Standards, National Institute for Medical Research*)
1965		
January:	Personnel research for the defence services	Sir Solly Zuckerman (*Chief Scientific Adviser, Ministry of Defence*)
February:	Permissible doses of radiation	Dr. E. E. Pochin (*Director, Department of Clinical Research, University College Hospital Medical School*)
March:	Private research foundations	Dr. L. Farrer-Brown (*lately Director of the Nuffield Foundation*)

REVIEW OF THE RESEARCH PROGRAMME

At approximately three-year intervals directors of research units and research groups and members of the Council's external scientific staff are invited to submit to the Council or to one or other of the Council's Research Boards a report on their work during this period; the Director of the National Institute for Medical Research reports annually. In this way the Council regularly review, in some detail, the work being undertaken in their research establishments and by individual members of their staff. The Council believe that the work covered by these reports will be of general interest and that the following brief account might usefully be included in their annual report.

National Institute for Medical Research

The National Institute for Medical Research, the largest of the Council's establishments, with its 150 scientists and 325 technicians, is engaged on something like 40 different research projects at any one time. Four examples will illustrate the range and variety of the Institute's work and its relationship—sometimes close, at other times more distant—to immediate, practical problems.

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A joint enterprise between the Divisions of Virology and of Biophysics has led to a remarkably complete determination of the molecular structure of adenovirus 5, a virus belonging to a group containing members thought to be implicated in the formation of tumours. By the use of antibodies directed specifically against (and therefore discriminating between) different proteins, it was possible to identify and purify three distinct protein constituents of the virus particle. High-resolution electron microscopy of the particle confirmed that it was a regular 20-sided solid (an icosahedron) and established that one protein element, in round subunits 80 Ä in diameter, formed the plane faces of the icosahedron, the second occupied the twelve vertices, and the third formed tail- or antenna-like structures sticking radially out from the vertices (plate I). The nucleic acid of the virus lies inside the icosahedron. The tail structures probably play some part in the attachment of the virus particle to the cell it infects. Of particular interest, and of importance for future research, is the power of cells infected by adenoviruses to provoke immune reactions, for such cells may become ' foreign ' to the body in a way not wholly accounted for by the ' foreignness ' of the virus itself.

Other workers at the National Institute have been studying the transplantation, from one dog to another, of the entire cartilaginous cap at the head of the femur. Because cartilage cells are enclosed within a matrix impermeable by blood vessels, grafts of cartilage do not succumb to the immunological reaction that normally prohibits the grafting of tissue between different individuals. The operation does, however, raise nice problems in surgery and results so far have been encouraging. This work has also entailed the analysis and solution of many biomechanical problems that arise in grafts subjected to movement and mechanical stress.

The next step is to solve the problem of storing cartilage—itself part of the wider problem of devising methods of storing large pieces of tissue or whole organs without loss of vitality. Here an important advance has been made: by adding the right amount of a protective agent (dimethylsulphoxide) progressively during cooling it is possible to prevent the concentration of salts that follows ice formation and damages the living cells or tissues; it is indeed possible to prevent ice formation altogether. Severe tests of this new technique of storage have shown it to be clearly superior to the older method, which relies on a single treatment or infusion with the protective agent before freezing.

Some years ago a systematic analysis of the actions of a number of pharmacologically active drugs on the various parts of the brain was begun at the Institute. This work has led to the formation of a new dynamic conception of temperature control, which is now known to depend on the action of mutually antagonistic drugs on the hypothalamic region of the brain; furthermore, a body of valuable knowledge on the site of action of a number of important pharmacological agents is accumulating.

The Institute is a principal centre of research on protein synthesis—particularly on protein synthesis in subcellular particles derived from mammalian cells. Two systems are under particularly intensive study in the Division of Biochemistry—the synthesis of haemoglobin by small particles (ribosomes) from very young red blood corpuscles, and the synthesis by a mouse virus of its characteristic coat of protein. One major problem is the isolation and purification of the agent (' messenger RNA ') that transcribes the genetic

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message contained in the nucleus into a form in which it can be used to assemble the constituents of protein molecules in their proper order. There seems to be a chemical linkage between the messenger and the ribosome that makes this a formidably difficult problem, but it is slowly yielding to systematic analysis.

Clinical Psychiatry Research Unit

Since the Mental Health Act was passed in 1960, community care as opposed to hospital treatment for psychiatric patients has become increasingly common and the Unit has been attempting to evaluate the new approach. Comparisons between a hospital- and a community-based service have shown that when a patient was a severe burden on the family admission to hospital was still commonly necessary even in the community service. In the short run, however, the community-based service, in spite of admitting to hospital a smaller proportion of the patients referred to it, appeared to give nearly as much relief to the families of patients as the hospital-based service.

Other social problems investigated have been suicide and the interaction between patients and their families. The high rate of suicide in the elderly has been shown to be related to loneliness, physical illness and lack of employment. Investigations into married couples where one partner is a psychiatric patient have shown that the patient's spouse has a higher than normal risk of developing a mental illness. The establishment of a clinic for chronic hypochondriacs has provided material for research into factors of significance in the development of psychosomatic illness. In addition, the Unit is working on techniques and apparatus for psychophysiological research in psychiatry, notably the analysis of electroencephalographs and their correlation with clinical states and psychological events.

Social Psychiatry Research Unit

Schizophrenia has occupied a central place in the work of this Unit. Recent studies have yielded encouraging results on the possibility of employing long-term schizophrenic patients and have shown the influence of family relationships and community after-care services on the course of the illness in short-stay patients after discharge from hospital; one finding of interest has been that if the degree of involvement between patients and key relatives is high readmission is more likely.

A second aspect of the Unit's work has been an extensive and long-term study of community attitudes to mental illness. Significant differences of attitude and consequent behaviour were found between and within groups of patients' relatives, mental welfare officers, general practitioners and students. The information and experience gained from this survey have paved the way for the development of objective methods of recognizing mental illness and assessing its prevalence.

The Unit has also carried out a variety of investigations on abnormal mental development in children, including the condition known as autism. Progress has been made in the understanding of the cognitive processes in mentally handicapped children, of the types of stimuli in the environment to which they respond, and of the effects on their development of different forms of upbringing and care, particularly in residential institutions.

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The Unit has continued to pursue its main aim of exploring the possible causes of mental illness and evaluating different types of treatment and psychiatric services with the aid of epidemiological techniques. The emotional illnesses or neuroses have been the principal object of study; these are particularly elusive of precise definition and yet demand investigation because they contribute substantially to the total of disability in the population. Studies in general practice have thrown light on the prevalence of neurosis in the community and on the medical history of neurotics over a period of years after identification. Special attention has also been paid to the problem of attempted suicide and the Unit has organized a service to provide for detailed investigation of every case admitted to the Royal Infirmary of Edinburgh in an attempt to assess the significance of clinical, social, demographic and ecological factors.

Another study has been concerned with the mental health of university students; this has revealed that 10 per cent of the men and 14 per cent of the women students under investigation were 'emotionally or nervously unwell' during their first year at university. In particular, high rates of emotional illness were found among those students who came from a background markedly different from that of the majority of their fellows, those from broken homes and those with parents whose attitude towards university education was unfavourable.

Psychologist members of the Unit have been developing tests to determine objective criteria for evaluating observations of patients' mental state and for measuring attributes of normal and abnormal personality. The Unit has also attempted to evaluate different therapeutic services, including the efficacy of out-patient treatment for psychiatric illness as provided by the community mental health clinic in Plymouth.

Social Medicine Research Unit

The aetiology of ischaemic heart disease is a central concern of this Unit. Epidemiological investigations have shown interesting relationships between occupation (particularly the degree of physical activity) and obesity, lipid metabolism and blood pressure levels, all of which are involved in the disease. Dietary studies of busmen and bank clerks are being made but they show no connection between diet and blood lipid levels. The Unit is at present trying to produce a simple method of assessing the amount of exercise individuals take during leisure with a view to relating this to the health of sedentary workers in middle age.

A recent investigation conducted by the Unit has demonstrated apparent association between season and the onset and progress of leukaemia; intensive work is proceeding in an attempt to elucidate this finding.

Another aspect of the Unit's work is concerned with juvenile delinquency in East London. The school as well as the neighbourhood seems to play an important part in its causation. Clinical social studies are also being made in an attempt to devise methods of predicting 'chronicity' from information available at the first appearance of a boy in Court.

The Unit is also engaged upon studies of the working of health services. For example, case-fatality in a wide range of conditions has been shown to be higher in non-teaching than in teaching hospitals and a large-scale survey is now under

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way to find out how these differences arise. The background of patients in various hospitals, their clinical condition on admission and their subsequent treatment are being studied.

Air Pollution Research Unit

This Unit is chiefly concerned with investigations of the composition of atmospheric pollution and the effects of pollution on health. The levels of gross pollution—in other words, the amounts of smoke and sulphur dioxide—are continuously monitored and any significant changes noted. New analytical methods have made possible detailed studies of the atmosphere of London streets and of certain industrial establishments, with special reference to pollutants such as sulphuric acid and polycyclic hydrocarbons (in particular the potentially carcinogenic 3, 4-benzpyrene). An investigation into pollution caused by motor vehicles has shown that black diesel smoke is not an important source of polycyclic hydrocarbons in the atmosphere; the problem of carbon monoxide is still being studied.

Work on the clinical effects of air pollution has so far centred on attempts to reproduce in volunteers in the laboratory the wheezing and dyspnoea frequently observed in people exposed to high concentrations of pollution, in order to gain understanding of the mechanisms involved.

Another important aspect of the Unit's work consists of epidemiological studies on the association between the intensity and composition of pollution and the incidence and severity of various forms of respiratory disease. A recent study has shown that patients with bronchitis tend to become noticeably worse during periods when the air pollution increases; studies on the incidence of lung cancer, however, suggest that air pollution may be a major cause of this disease only infrequently. Much more work, of course, remains to be done to increase our knowledge of lung cancer and other respiratory diseases, and the staff of the Unit are continuing to work in close collaboration with others in the field.

Cell Metabolism Research Unit

Among the major subjects studied by the Unit are the control mechanisms that regulate the metabolic activities of living cells and adapt them to changing circumstances. Many of these can now be understood in chemical terms on account of special properties of the key enzymes. The extent of catalytic activity of these enzymes can be modified by the concentrations of certain cell constituents, which act as ' signals ' and ' inform ' the catalyst of the metabolic requirements. These ' signals ' are of a feedback type. Gluconeogenesis and ketosis are processes which are being studied from this angle.

In correlating findings on isolated enzymes with metabolic events in the intact organ, it is often essential to have preparations of organs functioning outside the body under controlled conditions. A new preparation consisting of the surviving supradiaphragmatic portion of the rat has proved a valuable tool in the study of fat metabolism. Improved perfusion techniques for rat liver and rat kidney have opened up new approaches to metabolic studies.

Other work of the Unit has been concerned with the nature of the genetic code (in particular the elucidation of nucleotide sequences), with the metabolic processes whereby micro-organisms are capable of synthesizing all their cell

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constituents from compounds containing one carbon atom, with the mechanism of oxidative phosphorylation, with the use of ultrasound in the gentle disintegration of cells, and with the biochemistry of the inner ear tissues.

Wernher Research Unit on Ophthalmological Genetics

The study of hereditary affections of the retina remains central to the work of the Unit, and is largely concerned with the nature of the underlying metabolic anomalies involved. Work on retinal dystrophy in the rat has indicated that in affected tissues there is an abnormally low rate of protein synthesis and breakdown; there is some evidence that abnormalities in the oxidative pathway of glucose breakdown (the pentose phosphate shunt) may have an effect on protein synthesis at the nucleic acid level.

A possible approach to the understanding of hereditary retinal dystrophy is to study the metabolic mechanisms involved in the production of somewhat similar degeneration of the retina by a variety of experimental methods. It appears that sodium iodate and other retinotoxic substances may act indirectly through their denaturing action on retinal protein and those enzymes that influence the regeneration of visual purple (rhodopsin). Studies using rabbit retina have confirmed the report that, whereas other body tissues can function when supplied with vitamin A acid, vitamin A aldehyde is more specifically required by the retina.

It is likely that many hereditary diseases of the eye besides retinal dystrophy derive from an inborn error of metabolism, and the urine of a series of blind children and of a number of adults with such diseases is therefore being studied by chromatography; a few abnormal constituents have been identified but not clearly correlated with any disorder.

The data on retinitis pigmentosa in the Tristan da Cunha islanders have been submitted to genetic analysis, which shows that the gene responsible is recessive and now widely scattered in this closed community. A marked increase of cases is thus inevitable in the next generation.

Ultrasonography has been proved to be a reliable method for measuring the axial length of the eye and the other optical dimensions. The simplicity of the method gives it promising possibilities for work on the genetics and other aspects of refraction.

Human Biochemical Genetics Research Unit

This Unit has been mainly concerned with exploring the extent and nature of genetically determined enzyme variation in man. Such variations have for some time been known to be the basis of a number of rare metabolic disorders and also of certain idiosyncrasies in reactions to drugs, but there was no clear picture of the character or degree of enzyme diversity in the general population.

A variety of enzymes have been studied, chosen somewhat arbitrarily according to the availability of suitable techniques and material. Three new examples of genetically determined variation have been discovered. These involve the enzymes red-cell acid phosphatase, phosphoglucomutase and adenylate kinase. Detailed genetic analysis of the variants of serum cholinesterase and placental alkaline phosphatase have also been carried out. Other enzyme variants studied include those of serum alkaline phosphatase, lactate dehydrogenase and 6-phosphogluconate dehydrogenase. The findings make it clear that a considerable degree of diversity in the enzymic make-up of individuals must exist, and it seems likely that this is reflected in metabolic and other differences.

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These various enzyme polymorphisms are of potential value for linkage analysis, by which the genes controlling particular enzymes may be allocated to particular chromosomes or parts of chromosomes. A considerable number of data have been collected on families suitable for such studies, and a collaborative project is also being carried out with the Council's Clinical Effects of Radiation Research Unit in order to work out linkages in individuals with abnormal (' marker ') chromosomes.

Work will continue on the genetics, properties and structures of variant forms of human enzymes and also on their functional significance.

Population Genetics Research Unit

The work of this Unit is concerned primarily with the study of patterns of human variation in populations and with the factors determining the patterns and the frequencies of various characteristics, particularly those of medical interest.

The Unit has been active over a number of years in carrying out investigations to ascertain the frequency of all known sex-linked disorders within the Oxford Regional Hospital Board area. Since the blood group system Xg has a sex-linked mode of inheritance, Xg blood grouping is being carried out (in collaboration with the Council's Blood Group Research Unit) on patients with sex-linked diseases in the hope of obtaining more information about the relative position of genes on the X chromosome by means of linkage studies.

Another aspect of the Unit's work has been the detailed investigation of a number of conditions previously thought to be clinically identical but known to be inherited in different ways, and considerable success has been achieved in demonstrating clinical as well as genetic differentiation. Conditions investigated in this way include ichthyosis, hereditary deafness, and goitre associated with deafness. This has important implications because the clinical differentiation can provide a reliable basis for giving genetic advice. The staff of the Unit have also carried out a number of detailed clinical and genetic studies of patients suffering from muscular dystrophy, together with biochemical investigations designed to throw light on the fundamental properties of dystrophic muscle. The Unit also has excellent facilities for cytological work and a number of studies of rare chromosomal abnormalities are in hand.

Since 1962 the Unit has been conducting an international study of congenital malformations on behalf of the World Health Organization.

Blood Group Research Unit

The Blood Group Research Unit has been mainly concerned with the study of the mode of inheritance of the known blood groups and with the search for new ones. The red cell antigen systems are still a fruitful source of work; blood samples from many parts of the world continue to provide evidence for the existence both of ' new ' red cell groups and of subdivisions of previously recognized ones, and family studies are showing that some at least of the systems are under the control of more than one gene locus.

In the past it was the problems of haemolytic disease of the newborn and of adverse reactions to transfusion that initiated the supply of blood samples sent to the Unit. The increasing skill of the transfusion services has changed this situation, and now it is mainly the process of cross-matching before transfusion that promotes the discovery of blood groups and their subdivisions.

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Members of the Unit have found that a group-B-like antigen can be acquired on occasion by people of group A, most of them suffering from carcinoma of the colon. It is assumed that this antigen has been adsorbed on to the red cells from certain intestinal bacteria known to have a B-like antigen, and this finding provides an exception to the general rule that blood groups are purely genetic characters, uninfluenced by the environment.

In 1961 the Unit discovered Xg^a, the only blood group antigen so far known with a sex-linked mode of inheritance. This has opened up exciting possibilities of mapping the genes situated on the X chromosome in more detail and of obtaining evidence on the origin of certain sex chromosome abnormalities as well as providing, for inherited disorders, a test for sex linkage. The Unit is therefore now extending its research into these applications of blood grouping.

Blood Group Reference Laboratory

The Blood Group Reference Laboratory has been administered by the Council on behalf of the Ministry of Health since 1950, and since 1953 it has been recognized by the World Health Organization as the International Blood Group Reference Laboratory. Its routine functions as a reference laboratory are described on p. 106.

Much of the research work arises from the technical and clinical problems of blood grouping submitted to the Laboratory and from the need to develop and evaluate new methods. Many new blood group antigens have been investigated serologically and genetically, and one of these probably defines a new blood group system. The antigens of the gamma globulins (Gm and Inv groups) have also been investigated in the Laboratory.

In an endeavour to predict the degree of compatibility between donors and recipients of organ grafts and thus to aid in the selection of donors, leucocyte typing and compatibility tests have been used, as well as methods involving the reactions of living lymphocytes. Until well defined specific antigens determining compatibility have been characterized, the value of such tests can be assessed only by observing the long-term progress of patients and a statistical evaluation on this basis is now in progress.

The long continued work on the anthropological significance of the blood groups is being transferred to the Council's new serological population genetics laboratory, set up shortly after the period of this report at St. Bartholomew's Hospital, London. The prevalence of the various groups varies widely between different populations and races and the Laboratory has made a substantial contribution over the years to knowledge of blood group distributions and to its interpretation.

Gastroenterology Research Unit

The investigation of disorders of gastrointestinal motility plays a large part in the work of this Unit. So far, studies have been mainly concerned with the development and application of techniques—including, for example, the use of pressure-sensitive radio-pills and the labelling of gastric contents with small amounts of radioactive chromium—by means of which the muscular activity of the gut can be traced and analysed without causing undue discomfort and distress to the patient. Tentative results from some recent preliminary studies using these methods suggest that most of the pressure waves that are recorded

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in the stomach and intestine have the effect of delaying rather than propelling the contents and that only a slight gradient of pressure is needed to empty the stomach and move the contents through the intestine.

Another of the Unit's major interests is the study of patients who excrete large quantities of fat in their stools because they cannot digest and absorb foodstuffs properly. Again much of the work on this subject is concerned with the development of satisfactory methods of investigation; for example, new techniques have been devised for obtaining samples of the contents from all levels of the intestine for chemical and bacteriological analysis.

A third important aspect of the Unit's work has been to assess the efficacy of various drugs in the treatment of colitis, and of diets, drugs and gastric freezing in the treatment of ulcers of the stomach and duodenum.

Experimental Radiopathology Research Unit

The work of this Unit is aimed at elucidating basic radiobiological mechanisms, with an emphasis on topics having a potential bearing on radiotherapeutic practice. There seem to be no fundamental differences between normal and neoplastic cells in their response to radiation; indeed many methods of modifying radiation damage are applicable to all living cells, and it is convenient and economical to use micro-organisms as well as mammalian cells and tissues for radiobiological studies.

Previous reports had led to the belief that vegetative bacteria showed an important difference from higher cells in the way their radiobiological response varied with quality of radiation. However, experiments in this Unit, using the Council's cyclotron, have shown that there is a characteristic response of all types of cell, which is different in nature from that of subcellular units such as enzymes or of free viruses irradiated outside the cell.

A well known problem in radiotherapy is presented by the foci of anoxic, and therefore relatively radio-resistant, cells in solid tumours. The use of high-pressure oxygen during irradiation, or of fast neutrons rather than X- or γ-rays, are two methods of attack. Other possibilities are suggested by investigations with bacteria, which have shown that they are killed by at least two different mechanisms, one of which has the main responsibility for the ' oxygen effect '. It seems theoretically possible to find means of modifying the radiation response differentially, so that damage to anoxic cells would be enhanced to a greater degree than damage to cells that were fully oxygenated during irradiation. Yet another approach to this problem is suggested by the finding that when a small concentration of cupric ions is introduced into a bacterial suspension, irradiation in anoxic conditions converts these into cuprous ions, which are highly toxic. If they are found to be more toxic than cupric ions to mammalian cells also, and if it is possible to introduce cupric ions into tumours, a method of sensitizing specifically the anoxic cells will be available.

Work with tumours implanted in rats has shown that there is considerable variation between one tumour line and another in the proportion of anoxic cells present in a tumour. An incidental observation of potential practical importance was made on animals from which tumours had been surgically excised, some after irradiation. Of the irradiated rats, only one-sixth died later with chest metastases, compared with four-fifths of those that were not irradiated before the excision was performed.

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Dose-fractionation experiments with normal and neoplastic cells and tissues have demonstrated that, while the sparing effect of fractionation is in general less with fast neutrons than with X- or γ-rays, there is great variability in the extent to which it is reduced.

EVIDENCE SUBMITTED BY THE COUNCIL TO OFFICIAL COMMISSIONS

Committee of Inquiry into Experiments on Animals

During the period under review the Council accepted an invitation to submit evidence to the Home Office Committee of Inquiry into Experiments on Animals, under the chairmanship of Sir Sydney Littlewood, and their views on the working of the Cruelty to Animals Act, 1876, were presented to the Committee.

In their evidence the Council emphasized that experiments on animals were essential to the furtherance of medical and related biological research. Their general view was that the existing legislation for the control of such experiments was working satisfactorily, though they took the opportunity to suggest certain modifications of detail. A statement on the supply of animals for experimental purposes was appended to the Council's evidence.

Committee on Social Studies

The Council submitted both factual evidence and views on policy to the Committee on Social Studies under the chairmanship of Lord Heyworth. In their evidence the Council outlined the extent of their own involvement in research in the social sciences and, while expressing their intention to maintain their interests in the socio-medical field, indicated their strong support for the establishment of a Social Sciences Research Council.

University of Oxford Commission of Inquiry

Towards the end of 1964 the Council accepted an invitation to submit written evidence to the Commission of Inquiry set up under Lord Franks' chairmanship within the University of Oxford. Their evidence indicated the extent to which they supported research in the University and outlined the forms in which this support was given.

Attention was drawn in particular to the Council's scheme of research groups, and the circumstances that led to its introduction. The Council emphasized that the scheme was in no way an attempt to pass their responsibilities on to the universities, but that it had been devised primarily with the interests of the universities in mind. On the question of research units, the Council pointed out that a subject originally too speculative or too remote from existing academic interests to justify the support of a university, might well appear in the course of time to warrant absorption into the university framework.

RESEARCH ESTABLISHMENTS

COUNCIL VISITS

The series of visits to establishments supported by the Council continued, these being undertaken by smaller and more specialized groups of members than hitherto, accompanied on occasion by members of the Research Boards

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with scientific interests related to the work of the units being visited. Work in progress was seen at the following centres:

Aberdeen	Obstetric Medicine Research Unit
Cambridge	Abnormal Haemoglobin Research Unit
	Applied Psychology Research Unit
Cardiff	Pneumoconiosis Research Unit
Harwell	Radiobiological Research Unit
Leeds	Environmental Radiation Research Unit
	Mineral Metabolism Research Unit
London	Psychiatric Genetics Research Unit
	Social Psychiatry Research Unit
	Blood Group Reference Laboratory
	Blood Group Research Unit
	Trachoma Research Unit
	Biophysics Research Unit
	Institute of Cancer Research
Manchester	Paterson Laboratories, Christie Hospital and Holt Radium Institute
Newcastle upon Tyne	Demyelinating Diseases Research Group
	Research Group on the Relation of Functional to Organic Psychiatric Illness
Taplow	Rheumatism Research Unit

NEW RESEARCH UNITS

During the period under review the Council set up five new research units to provide long-term support for the expansion of work in particular fields, as follows:

The *Cellular Immunology Research Unit*, which is under the honorary direction of Professor J. L. Gowans (Henry Dale Research Professor of the Royal Society) at the Sir William Dunn School of Pathology, University of Oxford, is extending studies on the physiology and pathology of lymphoid tissues previously undertaken with the support of a research grant from the Council.

At King's College Hospital Medical School, the *Clinical Pulmonary Physiology Research Unit* has been set up in a new building provided for the purpose, under the direction of Dr. P. Hugh-Jones (formerly a member of the Council's external scientific staff at the Postgraduate Medical School of London). The Unit is mainly concerned with the investigation of the changes caused by disease in the distribution of air and the blood flow in different parts of the lung.

The *Cell Genetics Research Unit* in the Department of Genetics, University of Glasgow, under the honorary direction of Professor G. Pontecorvo, is undertaking research on the use of human and other mammalian cell cultures as a tool in genetic analysis.

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The *Brain Metabolism Research Unit* in the University Department of Pharmacology at Edinburgh, under the honorary direction of Professor W. L. M. Perry, aims to undertake experimental and clinical studies of the metabolic pathways of certain amino acids and other substances in the brain and in tissue fluids, in order to discover whether there are metabolic defects underlying the various psychoses, and ultimately whether such defects can be corrected.

Arrangements for the establishment of a *Microbial Systematics Research Unit* at the University of Leicester were concluded during the period under review. This Unit, under the direction of Dr. P. H. A. Sneath (who was formerly a member of the Council's scientific staff at the National Institute for Medical Research), will devote its main effort to revising and extending the classification of micro-organisms, with special emphasis on the use of numerical taxonomy and computer methods.

CHANGES IN RESEARCH UNITS

New directors were appointed to two research units. On the retirement of Dr. J. A. Fraser Roberts, FRS, from the directorship of the *Clinical Genetics Research Unit*, Dr. C. O. Carter, already a member of the staff of the Unit, became Director; and Dr. B. E. C. Nordin was appointed Director of the *Metabolic Disturbances in Surgery Research Unit*, on the retirement of the Honorary Director, Professor L. N. Pyrah. This Unit, which now has the title of *Mineral Metabolism Research Unit*, will be mainly engaged on research into the causes of renal stone, the dietary requirements of calcium and the metabolism of bone-seeking isotopes.

Following the resignation of Professor I. E. Bush from his university appointment and his post as Honorary Director of the *Unit for Research on the Chemical Pathology of Mental Disorders*, Dr. F. A. Jenner, a member of the Unit's staff, was appointed as Physician-in-Charge. Dr. W. Lane-Petter, the Director of the *Laboratory Animals Centre*, also resigned during the period under review; he has since been succeeded by Mr. J. Bleby.

Miss Ann Bishop, FRS, retired from the directorship of the Chemotherapy Research Unit, and this Unit has now been disbanded.

At the end of the period under review the Council's establishments consisted of the National Institute for Medical Research and 78 research units (including 4 overseas). Members of the Council's external staff continued to be attached individually to other institutions.

Information about all the Council's research establishments, including summaries of the research being undertaken, is given on pp. 79–163.

SUPPORT OF OTHER RESEARCH PROJECTS

RESEARCH GROUPS

In allocating their resources the Council recognize three broad requirements: training for research, short-term support for research and sustained support over longer periods. To assist in the training of young graduates the Council provide various scholarships and fellowships, which are listed on pp. 249–258. Short-term support by means of research grants was described in the last Annual Report (see also p. 202). Long-term support is provided by the Council

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in a number of ways—by the employment of staff at the National Institute for Medical Research and in various research units or individually in universities and hospitals, by the provision of special grants to autonomous institutions and also by financing the establishment of research groups within universities.

Support by means of a research group is intended for situations where the promotion of a particular line of research can best be met by accelerating its development in accord with the policy and interests of a particular university. Essentially, this means the provision of a block grant to the university to enable it to carry out its intended policy earlier than would have otherwise been possible, on the understanding that after a stated period the university will assume full responsibility for the further support of the work.

The research group scheme is of comparatively recent origin, the first groups having been established in 1960. Since then the scheme has grown, slowly at first but more rapidly in the period under review, as is shown in the following table:

	1960–61	*1961–62*	*1962–63*	*1963–64*	*1964–65*
No. of groups ..	4	7	9	16	28
Expenditure ..	£8,263	£41,925	£57,251	£127,698	£254,982

The new research groups for which the Council, during the period covered by this report, have agreed to provide support are as follows:

University	*Department*	*Research Group*
Birmingham	Experimental Pathology— *Professor P. G. H. Gell*	Basic Immunology
	Virology and Bacteriology— *Professor N. P. L. Wildy*	Virus
Bristol	Pharmacology— *Professor H. S. Heller*	Neurosecretion
Edinburgh	Molecular Biology— *Professor M. R. Pollock*	Bacterial Enzyme Variation
London		
University College London	Anatomy— *Dr. J. de C. Downer*	Cerebral Organization and Behaviour
Charing Cross Hospital Medical School	Medicine— *Professor H. E. de Wardener*	Renal Infection
Royal Free Hospital School of Medicine	Biochemistry— *Professor W. J. Whelan*	Glycogen Metabolism
St. Mary's Hospital Medical School	Wright–Fleming Institute Dept. of Immunology— *Professor R. R. Porter*	Structure and Biological Activities of Antibodies and Protein Antigens
University College Hospital Medical School	Clinical Haematology— *Professor T. A. J. Prankerd*	Haemolytic Anaemia
Postgraduate Medical School of London	Medicine— *Dr. J. B. West*	Clinical Respiratory Physiology
	Haematology— *Professor J. V. Dacie*	Haemolytic Mechanisms
Institute of Basic Medical Sciences, Royal College of Surgeons	Pharmacology— *Professor G. V. R. Born*	Thrombosis
Institute of Neurology	(*Dr. J. B. Cavanagh*)	Applied Neurobiology
Institute of Ophthalmology	(*Professor Barrie R. Jones*)	Oculogenital Virus

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University	*Department*	*Research Group*
London School of Hygiene and Tropical Medicine	Medical Statistics—*Mr. W. Brass*	Medical Demography
Sheffield	Biochemistry—*Professor W. Bartley*	Biochemistry and Physiology of Intracellular Organelles
Wales		
University College of South Wales and Monmouthshire	Biochemistry—*Professor K. S. Dodgson*	Biochemistry of Connective and Lung Tissue
	Microbiology—*Professor D. E. Hughes*	Structure and Functions of Micro-organisms

A list of research groups and details of the work on which they are engaged is given on pp. 186–201.

RESEARCH GRANTS

The Council have continued to make research grants to individual workers in aid of an extensive range of clinical and laboratory investigations. Over the years the number of grants awarded by the Council has grown considerably, as will be seen from the following table indicating the number of grants held at approximately ten-year intervals.

	1923–4	*1933–4*	*1939–45**	*1953–4*	*1964–5*
No. of grants held	176	205	235	271	857

The following table shows, for the past 10 years, the number of new grants awarded each year, the number of applications and the percentage of these that were successful.

	1955–6	*1956–7*	*1957–8*	*1958–9*	*1959–60*	*1960–1*	*1961–2*	*1962–3*	*1963–4*	*1964–5*
No. of grants awarded	143	124	152	179	211	236	260	282	388	516
No. of applications	165	142	185	201	228	274	325	351	432	607
% of applications successful	87	87	82	89	93	86	80	80	90	85

A complete list of the grant-holders and their subjects of research, arranged according to the geographical location of the institutions in which they have been working, is given on pp. 202–248.

OTHER ASPECTS OF THE COUNCIL'S ACTIVITIES

OVERSEAS LIAISON

During the period under review members of the Council's staff continued to visit many countries overseas to attend international and other congresses, to lecture, and to see and take part in research work at various centres. Several members of the staff were again granted leave of absence for varying periods of up to one year to work in academic centres abroad. Approximately eighty international congresses and meetings of a similar nature were attended by members of staff.

* Total number of grants held during the war years, annual figures not being available.

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Through the work of the Tropical Medicine Research Board and by their close liaison with the various regional Medical Research Councils and Committees, the Council have continued their interest and activities, both in the United Kingdom and in territories overseas, in many aspects of medical research in the tropics. Three members of the Tropical Medicine Research Board, Professor G. M. Bull, Dr. R. Lewthwaite and Professor A. W. Woodruff, accompanied by the Secretary of the Board, visited East Africa to attend the annual meeting and scientific conference of the East African Medical Research Council and a conference on research aid organized by the East African Common Services Organization, and to visit some of the main research centres in the region. Two members of the Board, Professor M. L. Rosenheim and Dr. R. Lewthwaite, with Professor J. C. Waterlow, attended the annual scientific conference and meeting of the Standing Advisory Committee for Medical Research in the Caribbean, and visited various research establishments in the area.

The Council continued to maintain, with support in some instances from the Department of Technical Co-operation (now the Ministry of Overseas Development) and other sources, their Laboratories in the Gambia, the Infantile Malnutrition Research Unit in Uganda, and the Tropical Metabolism and Epidemiological Research Units in Jamaica.

PATENTS AND AWARDS TO INVENTORS

Traditionally, the medical profession has been opposed to the patenting of discoveries because of the apparent conflict of patenting with the accepted principle that all new discoveries in medicine should be published immediately and made freely available to all. In practice, however, there need be no such conflict; the patenting of an invention need involve no delay in publication and the existence of a patent may well be a prerequisite for the industrial development of an invention or discovery and thus ensure its availability for general use, since manufacturers are reluctant to invest capital in a project in which they have no prior rights. Furthermore, patenting offers a safeguard against the exploitation by foreign industry of British discoveries unprotected in this way; such exploitation has in the past involved some British manufacturers in royalty payments to foreign competitors for the application of discoveries originally made in this country.

For these reasons the Council encourage members of their staff and others whom they support to apply for letters patent for discoveries that may be of potential commercial importance. In this the Council work closely with the National Research Development Corporation, whose major responsibility is to ensure the industrial development in the public interest of inventions made in the course of research supported from official funds; the rights in inventions made with the Council's support are usually assigned to the Corporation.

Many of the patents assigned to the National Research Development Corporation have proved to be profitable. The Council have therefore reviewed the position of their own staff in this regard and, in consultation with the Treasury and the National Research Development Corporation, have devised a scheme for making *ex gratia* awards to inventors from net royalties received by the Corporation. Under this scheme such awards may be made to the persons named in those Council patents that have earned net royalties, and to other workers who have contributed by their original work to an unpatented invention

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or development that has earned a net income. The total amount of any award made under this scheme is limited to one-half of the net earnings or to £2000, whichever is the less.

The Council have appointed a Committee, with representatives from the Treasury and the National Research Development Corporation, to advise them on such awards to inventors.

PUBLICATIONS

Two new volumes have been published in the Council's Special Report Series during the period under review. *The Cytology and Cytochemistry of Acute Leukaemias*—SRS 304—by F. G. J. Hayhoe, Dennis Quaglino and Richard Doll (1964) is an attempt to establish a definitive system of classification of the acute leukaemias on the basis of an intensive study of 140 cases. The monograph is illustrated with 74 colour plates and the dust jacket design won first prize in the technical books section of the *Scotsman* International Book Jacket Competition. *Abnormalities of the Sex Chromosome Complement in Man*—SRS 305—by W. M. Court Brown, D. G. Harnden, Patricia A. Jacobs, N. Maclean and D. J. Mantle (1964) presents 266 case records (from the Registry of Abnormal Karyotypes at the Council's Clinical Effects of Radiation Research Unit in Edinburgh), together with a discussion of some of the methods and principles of cytogenetics and a review of the literature in this field. The report is designed both as a handbook and as a source book of data for analysis by other workers.

In the series of Memoranda one new report (no. 42) appeared—*The Industrial Rehabilitation of Long-stay Schizophrenic Patients* (1964) by J. K. Wing, D. H. Bennett and John Denham; this is a study of 45 patients who were admitted to an Industrial Rehabilitation Unit. Three further Monitoring Reports (nos. 7–9) were issued, in the series entitled *Assay of Strontium-90 in Human Bone in the United Kingdom*; these cover the three six-monthly periods between July 1962 and December 1963. The pamphlet *The Exposure of the Population to Radiation from Fallout*—a report to the Medical Research Council by their Committee on Protection Against Ionizing Radiations (1964)—is an assessment of the radiation doses to human tissue likely to result from the nuclear weapon tests of 1961 and 1962. Finally, in addition to the Annual Report for 1962–63, the usual reprint of the scientific review articles in the report was published, under the title *Current Medical Research*; also reprinted in this volume is the Council's statement on responsibility in investigations on human subjects. All these reports were published for the Council by Her Majesty's Stationery Office.

The following reports (in addition to that of the Committee on Protection Against Ionizing Radiations referred to above) were produced by Council committees during the period under review:

Working Party on Pressure-Steam Sterilizers: Sterilization by steam under increased pressure. *Lancet* (1964) **2**, 193.

Working Party on Fractures in the Elderly: Incidence of fractures in persons over 35 years of age. *Brit. J. prev. soc. Med.* (1964) **18**, 130.

Committee on Influenza and Other Respiratory Virus Vaccines: Clinical trials of oil-adjuvant influenza vaccines, 1960–3. *Brit. Med. J.* (1964) **2**, 267.

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A memorandum prepared for the Climatic Physiology Committee of the Medical Research Council and the Subcommittee on Thermal Factors in the Environment of the US National Research Council: Nomenclature and classification of the disorders due to heat. *Lancet* (1964) **2**, 637.

Working Party on Anticoagulant Therapy in Coronary Thrombosis: An assessment of long-term anticoagulant administration after cardiac infarction. *Brit. med. J.* (1964) **2**, 837.

Measles Vaccines Committee: Vaccination against measles—a study of clinical reactions and serological responses of young children. *Brit. med. J.* (1965) **1**, 817.

As has already been mentioned, full details of the papers published by members of the staff and other research workers supported by the Council may be obtained from the Librarian at the National Institute for Medical Research.

COMMITTEES

During the period under review the Council set up a *Committee on General Epidemiology*, with Dr. Richard Doll as Chairman, to advise them on research in this field as a whole, including the development of its methodology.

The *Committee on Measles Vaccines*, originally set up on an *ad hoc* basis in 1962, was formally constituted under the chairmanship of the late Professor Wilson Smith; and the terms of reference of the *Virus Vaccines Safety Tests Committee* were extended to cover immunological products other than vaccines, its title being altered accordingly to *Immunological Products Advisory Committee*. The work of the *Committee for Research on the Toxicity Testing of Drugs* was expanded to cover pesticides and similar potentially toxic substances, and Professor A. C. Frazer, Professor R. B. Hunter and Sir James Cook, FRS, were appointed as additional members in view of these wider terms of reference.

The *Committee on the Control of Cross-Infection* was reconstituted as the *Committee on Hospital Infection* under the chairmanship of Professor R. E. O. Williams, with a subcommittee on engineering and architecture in relation to hospital infection and an *ad hoc* subcommittee on aseptic methods in operating theatres.

CONFERENCES

' Mathematics and Computer Science in Biology and Medicine ' was the title of a conference organized by the Council in association with the Health Departments and held in Oxford, at the Department of Engineering Science and at Balliol College, on 6–8 July last year. There were twenty-six papers, followed by discussions, on such subjects as data processing, record linkage, methods of classification, pattern recognition, and the use of mathematical and statistical models in a variety of medical and biological studies; and a demonstration was given of ' on-line ' computing by a transatlantic cable link-up with a compatible time-sharing system at the Massachusetts Institute of Technology. Nearly two hundred people were present, including representatives of computer manufacturing firms and Government departments as well as mathematicians and statisticians, biologists and medical workers, and the occasion provided a valuable opportunity for workers from many different disciplines to learn a little of each others' language and point of view. It is the hope of the Council that the conference will have done something to promote understanding of the rich potentialities of the new methods and approaches, and enthusiasm for exploration and experiment. The proceedings were published for the Council by

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Her Majesty's Stationery Office after the end of the period under review, and a review article on p. 27 of this report, in the section 'Some Aspects of Medical Research', discusses some of the topics dealt with at the conference.

In view of current interest in hyperbaric oxygen therapy a conference sponsored by the Council was held on 23 April 1964, under the chairmanship of Professor Hedley Atkins, to consider the present state of knowledge of the physiological and clinical aspects of hyperbaric oxygen therapy and the development of future research. A further conference, with particular reference to the use of hyperbaric oxygen in the newborn, was held on 7 January 1965 under the chairmanship of Professor D. V. Hubble.

ADMINISTRATION

FINANCE

The Parliamentary grant-in-aid to the Council for the year ending 31 March 1964 was £7,033,000 and for the year ending 31 March 1965 £8,753,000. This provision was augmented by contributions from other sources and the total funds received were as follows (the figures for 1962–63 are given for comparison):

	1962–63 £	*1963–64* £	*1964–65* £
Parliamentary grant-in-aid	*5,859,000*	7,033,000	8,753,000
Funds from Government departments and public bodies	*588,495*	663,448	686,755
Special grants from other bodies	*140,293*	123,441	76,069
Bequests, donations etc.	*28,855*	3,272	4,542
Miscellaneous sales and services	*91,752*	122,477	106,856

Further details of these contributions will be found in Appendices I and II (pp. 280–282).

The Council's detailed accounts for the two financial years 1963–1964 and 1964–1965 are shown in Appendix I (p. 280). In summary, the total expenditure for each year was allocated as follows (the figures for 1962–63 are again given for comparison):

	1962–63 £	*1963–64* £	*1964–65* £
Recurrent expenses	*6,242,664*	7,377,935	9,019,306
New buildings	*417,458*	481,286	460,121
Grants for special apparatus	*82,879*	87,705	149,707
	£6,743,001	£7,946,926	£9,629,134

The proportional allocation under the main heads of expenditure for recurrent expenses was as follows:

	1963–64 %	*1964–65* %
Administration	5·3	5·2
Central expenses	1·7	1·2
National Institute for Medical Research	14·5	13·8
Research units and external scientific staff	55·5	52·7
Research groups	1·6	2·8
Special grants	7·8	7·5
Temporary research grants and training awards	13·6	16·8
	100·0	100·0

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Benefactions

Under the terms of their Charter the Council are in a position to receive and administer private funds or properties entrusted to them by grant, gift or bequest, either for the general purposes of research or for research on specific subjects. A number of valuable additions to the Council's resources became available in this way during the period covered by this report and for these they wish to make grateful acknowledgement. Details of the benefactions are given in Appendix III (p. 283).

ACCOMMODATION

Clinical Research Centre

Planning continues for the Clinical Research Centre which is to be built at Northwick Park in collaboration with the North-West Metropolitan Regional Hospital Board. Tenders for the work are now under examination.

Present research establishments

Building projects completed during the year include extensions for the Toxicology Research Unit at Carshalton, the Pneumoconiosis Research Unit in South Wales, the Rheumatism Research Unit at Taplow and the Clinical Effects of Radiation Research Unit in Edinburgh. Work has been completed on alterations to the laboratories for the clinical wing of the Neuropsychiatric Research Unit at West Park Hospital, Epsom, and to the accommodation occupied by the Atheroma Research Unit in Glasgow and the Clinical Endocrinology Research Unit in Edinburgh. A small extension of laboratory accommodation for the Division of Biological Standards of the National Institute for Medical Research and a prefabricated building to serve as a clinic for the Epidemiological Research Unit in South Wales have also been completed. At the Council's Laboratories at Hampstead the modernization of the boiler installation has been finished. Work is in progress on an extension for the Cyclotron Unit and the Experimental Radiopathology Research Unit at Hammersmith, mainly to replace existing areas that have to be given up, and a small extension to the Council's Central Store at Colindale has been started.

Planning is in progress for a small extension to the Bone-Seeking Isotopes Research Unit at Oxford, and plans are also in hand for the conversion of the old library into laboratories at the Council's Laboratories at Carshalton.

In association with University College London new accommodation is being provided for the Experimental Genetics Research Unit. An extension has been completed on behalf of the Ministry of Health to the building used by the Blood Products Laboratory at Elstree.

PERSONNEL

MEMBERSHIP OF COUNCIL AND RESEARCH BOARDS

Council

The new members of Council appointed from 1 October 1963 were Professor W. D. M. Paton, FRS, and Professor Hedley Atkins. At the end of the 1963–64 session Professor T. Crawford and Professor W. M. Millar retired on completion of their term of service as Council members, being succeeded by Professor

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A. R. Currie and Professor Martin Roth. Sir Edward Collingwood, FRS, who also completed a four-year period of service, was reappointed to the Council from October 1964; he continues as Treasurer.

On relinquishing his seat in the House of Commons in September 1964, Sir Hugh Linstead ceased to be a member of Council and was succeeded by Mr. Austen Albu, MP. Mr. Albu, however, resigned shortly afterwards on taking up ministerial office and was succeeded by Mr. Arthur Blenkinsop, MP. Professor M. M. Swann, FRS, ceased to be a member of Council early in 1965, on his appointment as a member of the Council for Scientific Policy.

Clinical Research Board

The Council wish to pay special tribute to Professor Sir Edward Wayne, who retired in September 1964 from the chairmanship of the Clinical Research Board; in this capacity Sir Edward gave invaluable service for over four years. He has been succeeded by Professor Sir Robert Platt.

Other changes on the Clinical Research Board included the appointment of Professor C. H. Gray in place of Dr. J. H. F. Brotherston, who succeeded Sir Kenneth Cowan as Chief Medical Officer, Scottish Home and Health Department, and thus became the Department's Assessor to the Board (and also to the Council); and the appointment of Professor M. F. A. Woodruff to fill the vacancy created on the retirement, under the rota system, of Professor J. G. Scadding.

Biological Research Board

Professor R. E. Coupland, Professor J. N. Davidson, FRS, and Professor D. Whitteridge, FRS, became members of the Biological Research Board in place of the late Professor Payling Wright and, on their retirement under the rota system, of Professor I. E. Bush and Professor B. Katz, FRS.

Tropical Medicine Research Board

Professor W. E. Kershaw resigned his membership of the Tropical Medicine Research Board during the early part of the period covered by this report and was succeeded by Professor T. Wilson; and on the retirement of Dr. R. Lewthwaite and Professor G. Macdonald and the resignation of Professor Sir Herbert Seddon, Dr. L. G. Goodwin, Dr. A. M. Thomson and Dr. F. J. Wright were appointed in their places. On his retirement as a member, Dr. Lewthwaite became an additional Assessor to the Board.

HONOURS

The Council noted with much pleasure the following honours bestowed by Her Majesty the Queen during the period under review:

Baron (Life Peerage):	Sir Howard Florey (*President of the Royal Society and former member of Council*)
Baronet:	Sir Charles Dodds (*former member of Clinical Research Board*)
Knight Bachelor:	Dr. J. H. Gaddum* (*former member of Council*) Professor J. McMichael (*former member of Council*) Professor A. A. Moncrieff (*former member of Clinical Research Board*)

* Died 30 June 1965.

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Knight Bachelor—(*contd.*)	Professor H. J. Seddon (*member of the Tropical Medicine Research Board and former member of Council and Clinical Research Board*)
	Professor E. J. Wayne (*former member of Council and Chairman of Clinical Research Board*)
CB:	Dr. F. F. Main (*Northern Ireland Ministry of Health and Local Government Assessor to the Clinical Research Board*)
CMG:	Professor P. C. C. Garnham (*member of Tropical Medicine Research Board*)
CBE:	Mr. W. Binks (*Director, Radiological Protection Service*)
	Dr. F. J. C. Herrald (*Headquarters Office*)
	Professor R. G. Macfarlane (*Director, Blood Coagulation Research Unit*)
	Professor A. Neuberger (*member of Council*)
	Professor R. Milnes Walker (*former member of Council and Clinical Research Board*)
MBE:	Mr. E. J. Lucas (*Senior Technical Officer, Radiobiological Research Unit*)

The Council learned with pleasure also of the following elections to the Fellowship of the Royal Society:

Sir Edward Collingwood (*member of Council*)
Dr. W. Hayes (*Director, Microbial Genetics Research Unit*)
Dr. S. Brenner (*Laboratory of Molecular Biology*)
Dr. C. E. Ford (*Radiobiological Research Unit*).

The Council were glad to note the following other honours gained by members of their staff:

Dr. P. M. D'Arcy Hart (Director, Tuberculosis Research Unit), the 1964 Stewart Prize of the British Medical Association in recognition of his work on the origin and spread of epidemic diseases; Dr. A. C. Allison (National Institute for Medical Research), the Frederick Murgatroyd Prize for 1963 in recognition of his contributions to tropical medicine; Professor E. G. L. Bywaters (Honorary Director, Rheumatism Research Unit), a Gairdner Foundation Award for his clinical studies of rheumatoid arthritis; Dr. L. Brent (National Institute for Medical Research), the Scientific Medal of the Zoological Society of London; Dr. O. G. Edholm (National Institute for Medical Research), the William Julius Mickle Fellowship of the University of London for 1963; and Dr. D. E. Broadbent (Director, Applied Psychology Research Unit), the 1963 Vernon Prize of the National Institute of Industrial Psychology.

OBITUARY

Professor G. Payling Wright

The Council learned with much regret of the death on 4 April 1964 of Professor G. Payling Wright, to whom they had long been indebted as a wise and friendly adviser; at the time of his death he was a member of the Biological Research Board, and from 1956 to 1960 he had been a member of Council.

As Sir William Dunn Professor of Pathology at Guy's Hospital Medical School from 1934 until his retirement in 1963 Payling Wright exerted a unique influence in the field of pathology. In his own research, at which he worked to the end of his life with tireless energy, his achievements were wide ranging; but perhaps his greatest contribution was his continued advocacy of the need for experimental investigation in pathology. He was essentially a scholar, a man of wisdom and of deep knowledge; he had immense enthusiasm and the gift of stimulating others, and he showed unfailing kindness to everyone with whom he had contact.

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Professor R. F. A. Dean 37

The death of Professor R. F. A. Dean, Director of the Infantile Malnutrition Research Unit, Kampala, Uganda, on 2 December 1964 was a sad loss to the Council and to the field of nutritional science in general. Professor Dean joined the Council's service in 1944. His work with Professor McCance on malnutrition in German children at the end of the Second World War received particular acclaim, and showed his flair for correlating the practical with the theoretical aspects of such problems.

Dean was invited by the Council to set up a group for the study of infantile malnutrition at Kampala in 1953. Under his leadership the work of this Unit gained widespread recognition not only through its scientific distinction but also by its practical influence; it is largely as a consequence of his work that severe cases of the protein-deficiency disease kwashiorkor are now rarely found in Uganda. His biochemical researches and those of his staff have done much to reveal the nature of the underlying metabolic disturbances and have thus made possible a fundamental understanding of the disease. As a clinician he always set the highest standards, putting the welfare of the children under his care before everything; indeed, his name today is a household word among the people around Kampala.

Dean's contributions in the field of tropical nutrition continued to increase in value, although he suffered progressive ill-health during the last nine years of his life—as a result of an obscure virus infection that he contracted from a child he attended in a jungle village during a visit to Malaya. He will be remembered no less for his fortitude in such adversity than for his many scientific achievements.

HEADQUARTERS OFFICE

In view of the increasing complexity and volume of work now coming to them, and of the general reorganization of the provision for civil scientific research in this country following the report of the Committee of Enquiry into the Organization of Civil Science, the Council have recently given close consideration to the future organization of their Headquarters.

As their chief executive officer, the Secretary will continue to have the ultimate responsibility to Council for all scientific and administrative matters relating to their policy but, to meet the increased needs, it has been agreed that, in future, he should have a distinguished scientist as his immediate delegate and deputy. The holder of this post will be known as Second Secretary and the Council are greatly indebted to Sir Charles Harington for agreeing to hold it, in an acting capacity, pending the making of a permanent appointment.

Under the overall authority of the Secretary the responsibility for the administrative functions related to the Council's activities will be in the hands of an Administrative Secretary. Mr. D. A. Smith, an Under-Secretary in the Civil Service, has been seconded to this post from the Inland Revenue Department.

On completion of his period of secondment to the Council in the post of Deputy Secretary, Mr. C. Y. Carstairs took up an appointment in the Research and Development Division of the Ministry of Public Building and Works.

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The Council wish to pay special tribute to Miss Ann Bishop, FRS, who has retired from their staff. Dr. Bishop was Director of the Chemotherapy Research Unit since it was set up in 1942 and was a member of the Council's staff for some years before this. Her contributions to research in chemotherapy and parasitology, particularly in relation to drug resistance in malaria, have been widely recognized. Dr. Bishop is continuing her work with the support of a research grant from the Council, who are happy to know that her association with them is continuing.

The Council also wish to acknowledge, on the occasion of his retirement from the directorship of the Clinical Genetics Research Unit, the contribution of Dr. J. A. Fraser Roberts, FRS, to research in genetics. His work on hereditary factors in developmental abnormalities and in disease have suggested new approaches for investigation, both in his own and in other fields; and the Council are gratified that Dr. Fraser Roberts, who now has a personal research grant, will continue his work under their auspices.

Long and distinguished service has also been given by the following senior members of the Council's scientific staff, who retired during the period under review: Dr. J. O. Irwin and Dr. W. J. Martin (both of the Statistical Research Unit); Dr. T. Moore and Dr. E. M. Cruickshank (both of the Dunn Nutritional Laboratory); Dr. J. D. Fulton (National Institute for Medical Research); and Dr. H. W. Laser (external scientific staff, Molteno Institute, Cambridge).

Among the members of the scientific staff who left the Council's service during this period on appointment to senior posts in universities and other centres were the following:

Dr. M. Hamilton (external scientific staff):	Nuffield Professor of Psychiatry, University of Leeds
Dr. S. M. Hilton (National Institute for Medical Research):	Professor of Physiology, University of Birmingham
Dr. D. E. Hughes (Cell Metabolism Research Unit):	Professor of Microbiology, University of South Wales and Monmouthshire
Dr. R. Illsley (Obstetric Medicine Research Unit):	Professor of Sociology, University of Aberdeen
Dr. J. F. Nunn (external scientific staff):	Professor of Anaesthetics, University of Leeds
Dr. C. Osorio (external scientific staff):	Professor of Physiology and Biochemistry, University of Granada Medical School, Spain
Dr. R. H. Pritchard (Microbial Genetics Research Unit):	Professor of Genetics, University of Leicester
Dr. K. Rawnsley (Social Psychiatry Research Unit):	Professor of Psychological Medicine, Welsh National School of Medicine
Dr. J. Tizard (Social Psychiatry Research Unit):	Professor of Child Development, Institute of Education, University of London
Dr. B. M. Richards (Biophysics Research Unit):	Reader in Biology, King's College, London
Dr. P. H. Venables (Social Psychiatry Research Unit):	Reader, Department of Psychology, Birkbeck College, London

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Dr. N. G. Waton (National Institute for Medical Research):	Senior Lecturer in Pharmacology and Physiology, University of Strathclyde
Dr. F. A. Chrenko (National Institute for Medical Research):	Principal Lecturer in Environmental Engineering, and Deputy Head, National College for Heating, Ventilating, Refrigeration and Fan Engineering (Borough Polytechnic), London
Dr. R. L. Morgan (Cyclotron Unit):	Consultant Radiotherapist, Royal Marsden Hospital, London

STAFF NUMBERS

The number of staff employed by the Council at the beginning of January 1965 was 3258. This figure was made up of 855 scientific staff (including 52 part-time), of whom 262 were medically qualified, 1319 technical staff (including 28 part-time), 651 administrative and clerical staff (including 77 part-time) and 433 maintenance staff (including 128 part-time). In addition, 106 locally recruited staff were employed in the Gambia and in Uganda.

ADVISERS AND ASSESSORS

The Council wish to express their gratitude to all the medical and other scientists, in addition to members of their own staff, who have given them their assistance and advice, whether in an individual capacity or as members of special committees.

The Chief Medical Officers of the Ministry of Health and the Scottish Home and Health Department, the Chairman of the University Grants Committee, the Chairman of the Science Research Council (previously Secretary of the Department of Scientific and Industrial Research), the Secretary of the Agricultural Research Council and the Chairman of the Clinical Research Board are assessors, *ex officiis*, to the Council. A further assessor is nominated by the Royal Society on the Council's invitation. Sir George Godber (Ministry of Health), Dr. J. H. F. Brotherston (Scottish Home and Health Department), Professor A. A. Miles (Royal Society) and Professor Sir Edward Wayne and Sir Robert Platt (Clinical Research Board) attended meetings in their capacity as assessors. Sir Kenneth Cowan (Scottish Home and Health Department) and Sir Lindor Brown (Royal Society) also attended in this capacity during the early part of the period under review. The Secretaries of the Department of Scientific and Industrial Research and of the Agricultural Research Council and the Chairman of the University Grants Committee received papers on a reciprocal basis.

SHAWCROSS

Chairman of the Medical Research Council

HAROLD HIMSWORTH
Secretary of the Council
20 Park Crescent
London W.1.

24 June 1965

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The following articles review advances made over a number of years in some of the subjects with which the Council are concerned. It should be noted, however, that in order to give a balanced picture of the progress made in these fields the scope of the reviews is not confined to work sponsored by the Council.

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COMPUTERS IN MEDICINE

The idea of an automatic computer has existed for over 130 years, ever since Charles Babbage began to design his 'Analytical Engine'. This remarkable conception included nearly all the features of the modern computer, and the design was actually completed. It was, however, built only in part, and it is doubtful whether a purely mechanical apparatus of such complexity could have functioned satisfactorily. A practicable machine had to await the advent of the science of electronics, and the first electronic computers began to function in the late 1940's. In the last 15 years development has been rapid, and it continues to be so.

In spite of all that has been written about computers, there is still widespread misconception of their capacities. The term 'electronic brain' has probably done most harm in leading people to believe that the machines can think for themselves. It is still sometimes suggested that the fact that results have come from a computer is in itself a mark of their excellence; and the suggestion is often made, when there is doubt about the appropriate method of analysing some figures, that the data should be fed to a computer, as if that suggestion solved the difficulty.

It is worth restating therefore that a computer can do nothing without being given precise instructions for every stage of the job, and that it can solve nothing that could not be solved by a sufficient number of people with pencils, paper and unlimited time. The sole advantages of a computer over pencil and paper are those of speed, accuracy and economy. These advantages are, however, so great that they have opened up wholly new fields for human thought, in the same way as the microscope extended the range of what was visible, and chromatography the range of what could be analysed chemically. In biology computers have already established their position as indispensable tools for the analysis of the structure of proteins from X-ray diffraction patterns, but their use has not yet permeated widely into medicine and the extent of their potentialities has not been generally recognized by medical research workers.

The Council therefore, in association with the Health Departments, organized a conference with the object of bringing mathematicians, statisticians and computer scientists together with medical biologists and clinicians. The conference, which was held at Oxford on 6–8 July last year, was attended by nearly 200 people and the programme ranged widely, from the uses of computers in the processing of hospital statistics to their use in the development of models of the electrical activity of the brain. All the groups of specialists present had something to offer and something to learn from each other and the interchange of ideas proved so stimulating that the papers and ensuing discussions have been published (Medical Research Council, 1965). A report of a similar conference held one year previously in the United States has also been published (Proceedings of Rochester Conference, 1964) and together these two symposia describe an extensive sample of the many new opportunities that have been presented to medical research workers by the development of computers.

Pattern recognition

Some of the most promising opportunities relate to non-numerical problems, such as the automatic analysis of the photomicrographs obtained from routine microscopy. Whether this will eventually prove to be practicable is still

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uncertain, but sufficiently encouraging results have been obtained to suggest that it may be possible to instruct a machine how to recognize a malignant cell in a Papanicolaou smear or abnormal chromosomes in the nuclei of otherwise normal cells. (The exercise of trying to define for a computer the criteria by which it must operate is in any case an extremely valuable one and may greatly help to sharpen diagnostic criteria.)

For either of these purposes, it is necessary to have an instrument that will describe a picture in terms of its constituent points (that is, ' digitize ' it) and a set of rules that will enable the computer to analyse the digitized picture. Instruments which will digitize film negatives are now available and one of them (FIDAC) was described by an American worker, Dr. Robert S. Ledley, at the Oxford conference (see also Ledley, 1964). In 0·2 second this instrument examines approximately 350 000 points on a film negative, codes each on the basis of its light density by one of the numbers 1–7, and feeds the information into an IBM computer; the points are so tightly packed that no information on the photomicrographs is lost. Plates II and III show a print-out of a chromosome picture in the form in which it is recorded in the computer's memory together with the original photomicrograph. A binary coding system also exists for the analysis of black-and-white pictures; in this system about 800 000 points on a negative can be scanned.

Programming systems (that is, sets of rules or basic concepts for forming sets of rules) for analysing the mass of information fed into the computer have not yet been developed to a useful stage, although possible methods of approach have been put forward and a program is in existence for some aspects of the analysis of an uncomplicated chromosome picture. The crucial difficulty is the recognition of overlapping chromosomes and the identification of the two individual chromosomes involved. It is by no means certain that this can be achieved; but, if it can, automatic chromosome analysis may become a practical proposition within a few years. Ultimately the intermediate step of micro-photography should be eliminated and the scanner linked directly to the chromosome preparation, the cells for analysis also being selected automatically.

The advantages that would accrue from this type of automatic microscopy derive from the scale of the work that could be undertaken. Examination of secretions for the detection of early malignancy—for example of the uterine cervix—could be undertaken at frequent intervals on a national scale, and chromosome analysis could be used to pick up abnormalities that occur in only a small proportion of cells or a small proportion of the population. The potential value of such chromosome examinations has been demonstrated by Dr. W. M. Court Brown and his colleagues in the Council's Clinical Effects of Radiation Research Unit. Working with the Atomic Energy Research Establishment they have shown that it is possible to detect the effect of quite small doses of radiation, even if these have been received over many years, by measuring the amount of chromosome damage in circulating lymphocytes (Court Brown, Buckton and McLean, 1965). If such studies could be carried out on a large enough scale they might form the basis of a genuinely biological form of monitoring that could be used for the purpose of radiological protection. Such chromosome damage occurs, however, in only a few cells in any 1000 analysed, and the possibility of making sufficiently accurate quantitative measurements depends on the successful automating of the process. The Council have therefore purchased a FIDAC machine to be used in conjunction

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with the IBM 7090 Computer at Imperial College, London, and work on the development of an automatic process will be carried out under the general direction of Professor S. Gill and Dr. W. M. Court Brown.

Statistical applications

The computer has aided the statistician in two principal ways. First, by relieving him of the tedium of routine analysis it enables him to devote his time to his proper function of interpreting the results of the analysis and planning further experiments. Even with generous clerical assistance there was, previously, always the need to keep a close check on the accuracy of the calculations, but once a computer program for a routine procedure has been prepared and tested the subsequent results can be accepted with only the most cursory checking. Moreover, the general acceptance of a single international programming language (ALGOL 60) will mean that once a computing procedure for solving a particular problem has been worked out it can become available for use on all computers. As a result, relatively complicated methods of analysis can be used routinely by research workers, without the assistance of mathematical colleagues. For example, the development of a program to fit survival curves to data on cancer induction in experimental animals would mean that cancer workers could always present their data on experimental carcinogenesis in a mathematically efficient way, and so avoid the false impressions that may be conveyed by less complete forms of analysis.

Secondly, the statistician is no longer restricted to methods of analysis that involve only a small amount of calculation. This means that he is now free to make routine use of the methods of multivariate analysis, which have been known for many years but which have seldom been used because of the amount of labour they involve. These techniques have been used in the analysis of the results of clinical trials of new treatments for acute leukaemia and for pulmonary tuberculosis (MRC Working Party on the Evaluation of Different Methods of Therapy in Leukaemia, 1963; Radhakrishna, 1963). Not only have they ensured that the results are interpreted more accurately than was previously possible by enabling allowance to be made for differences existing before the trial between the groups receiving different treatments, but they have at the same time provided new information about the prognostic importance of the clinical features of the disease.

Perhaps even more important, it is now practicable for the statistician to make use of randomization tests for testing the statistical significance of observed results. For example, this type of test has provided a solution to the historic problem of how to recognize small epidemics of a disease that is always present in the community. The method was suggested by Knox (1964) for studying leukaemia in children. Knox examined 185 cases of leukaemia which occurred in children under 10 years of age in two English counties between 1951 and 1961 and found that 10 of the 96 non-myeloid cases occurred in pairs, each pair of children living within one kilometre of one another and developing the disease within a period of two months. The problem then arose whether the number of pairs was more than could be expected by chance. The answer was obtained by repeatedly re-allocating at random each of the 96 dates of onset to the 96 places of residence, and showing that so many pairs of neighbouring cases would occur by chance only once in about 500 times. To do this without a computer would have been quite impracticable. With London University's Atlas

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computer each set of re-allocations, together with the correlations of the time interval and the distance between each pair of cases and the grouping of pairs according to the degree of clustering, was carried out in less than half a second.

Numerical taxonomy

The general problem of classification is less acute in medicine than in some other sciences, since any classification of patients is tested in the long run pragmatically—by its usefulness in indicating methods of effective treatment rather than by its fit to any preconceived theoretical system of relationships. Separation of disease entities is, however, often a prerequisite for successful research into aetiology, and an objective means of classifying patients might make a notable contribution to knowledge in those parts of medicine where the causes of disease are still largely unknown.

Numerical taxonomy provides one such method. It was developed for classifying animals and plants; but, as Sneath and Sokal have shown, its general principles can be applied to any field (Sneath and Sokal, 1962; Sokal and Sneath, 1963). It has become practicable only with the advent of electronic computers, because the number of data that has to be handled, if the analysis is to yield a unique classification, is immense. In brief, the method consists in determining a large number of characters (50 or more) for each of the entities that have to be classified, comparing each entity with every other, estimating the overall resemblance of each pair and then grouping so as to provide the sharpest segregation of entities that show a high degree of similarity to one another. The method has been used extensively for the classification of bacteria (see Sneath, 1964), but its application in clinical medicine and pathology has only recently begun. An example is provided by the work of Hayhoe, Quaglino and Doll (1964), who examined the cytological and cytochemical characteristics of the blood cells in 137 patients with acute leukaemia and found that a classification into four groups with little overlap emerged and that nearly all the cases fitted fairly well into one or other of them. The groups corresponded approximately to the conditions recognized as lymphoblastic, myeloblastic and monocytic leukaemia and erythraemic myelosis. The analysis indicated that further subdivision was not called for and demonstrated which diagnostic criteria were most useful for discriminating between the groups.

Automated diagnosis

Diagnosis by computers is unlikely to be a practical possibility on a large scale in the near future, but there can be no doubt that the computer will eventually prove to be an important aid towards reaching a correct diagnosis. That is not to say that a computer will replace the doctor, but the doctor will turn for assistance to the computer in the same way as he now turns to the laboratory for the results of an appropriate test. Sir Marfarlane Burnet has said: ' The progressive transfer of decision-making to data-processing machines . . . may well become the characteristic feature of hospital medicine within the next 50 years ', and ' I can see no escape from the contention that if judgement is to be based on experience, then a machine which can give accurate weight to all the relevant information and express the judgement in terms of a quantitative probability will give a more acceptable answer than any clinician '. (Burnet, 1964.)

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At the present time, the difficulty in making use of a computer is that the basic data required for its use have not been collected in a sufficiently systematic way. One set of data that has been collected relates to the differential diagnosis of the various types of congenital heart disease (Warner *et al.*, 1961). This has been used in the United States to compare the diagnoses provided by a computer with those given by physicians working from the same items of information (Gustafson *et al.*, 1964). It was concluded that the computer has proved 'a wise colleague to the paediatric cardiologist and a superior consultant to members of a general hospital staff specifically interested in congenital heart disease'.

The best method for the analysis of the data has not yet been worked out. Many methods are possible. None of them present intrinsically difficult mathematical problems, and the principal difficulty will continue for many years to be the shortage of adequate information for the computer to work on.

Record linkage

A great deal of medical information is collected about everybody—by registrars of births, marriages and deaths, general practitioners, hospitals, local authorities, schools and the Ministry of Pensions and National Insurance and other Departments—but it is used solely by the authority that collects it, and very little of the information about an individual is ever brought together in one place. Before the advent of computers, any attempt to produce an integrated record for an individual would have been prohibitively expensive. Now, however, the revolution in data processing techniques has advanced so far that integrated recording is not only practicable but, if the present system of collecting data were fully rationalized, could probably be carried out with little or no additional expense.

That the project is practicable has been demonstrated in Canada, where Newcombe and his colleagues showed that a computer can be used to identify records relating to the same individual, even though they are derived from different sources and lack a common identifying number (Newcombe and Kennedy, 1962). Further evidence has now been produced in this country, where Acheson (1964), with the financial support of the Nuffield Foundation, has initiated a pilot scheme known as the Oxford Record Linkage Study, which relates to a population of 325 000 persons living round Oxford. This study cannot be expected to provide in itself much information of research interest, because the population is too small; but it will provide a basis for considering the possibility of a national scheme. It has shown, for example, that more identifying data would be needed on birth, marriage and death certificates and in the summary sheets of in-patient hospital records. Minor changes of this sort would facilitate a great deal of research—relating, for example, to associations between diseases, long-term prognosis, the morbidity and mortality of particular social groups and the pattern of disease in families; and basic research on population genetics would be made practicable for the first time.

Analysis of nervous activity

Computers may become an essential tool in the study of the nervous system. Small special-purpose digital computers are already being widely used for studying the electrical responses of the human brain to sensory stimulation. These small machines are also being used both for studying directly the

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statistical characters of the discharges of single nerve cells (Burns and Smith, 1962; Burns, Heron and Pritchard, 1962; Burns and Pritchard, 1964) and for preparing the data on these discharges for more detailed examination by larger, general-purpose computers. For example, by deriving cross-correlograms between apparently irregular discharges from widely separated parts of the brain it may be possible to tell whether one part 'leads' the other in time and the order of conduction or propagation delay between them.

In the field of electroencephalography, quantitative assessment of changes in the EEG records, whether they result from the progress of disease or from experimental conditions, involves the handling of very large quantities of data. For this reason none of the many methods of analysis proposed so far has been widely adopted. However, with the advent of automatic methods for measuring the records and digitizing the data obtained, the application of computers to EEG analysis is being investigated.

Computer analysis of the EEG seems unlikely to supersede the rather elaborate processes of pattern recognition used by a trained interpreter of these records; the processes of visual EEG analysis can as yet hardly be reduced to logical terms suitable for machine handling. It seems likely, however, that quantitative information, of a type that even a skilled observer cannot obtain by inspection, may be extracted from the records by computer analysis, whether digital or analogue (Byford, 1965), and that this will be at least a valuable supplement to his judgments.

Simulation of biological functions

In some circumstances analogue computers are more convenient than are digital computers—for example, when models representing the interchange of substances between different compartments of the body are being tested against experimental observations. The analogue computer is comparatively cheap, and it is possible for the investigator to have one of his own which is always available, and for which he can make rapid changes of program as required. The functional analogue, in which the computer simulates the mathematical equations rather than the biological system directly, is the most flexible and the most widely used. Applications to medicine include the study of the action of drugs (Paton and Waud, 1964) and of ion flux in nerve cells, and simulation of the dynamics of the cardiovascular system. In the respiratory field it has been used to test a model of the system of carbon dioxide storage in the body (Grodins *et al.*, 1954–55; Defares, Derksen and Duff, 1960; Grodins and James, 1963), and the simulated ventilation response to increased alveolar carbon dioxide tension has been found to fit the experimental results well; it has been applied to anaesthesia by Mapleson (1963) in an investigation of the uptake and exchange of inert gases and other agents. The analogue computer is particularly useful for studying the movements of radioactive tracers, and it has recently been applied to the distribution of radioactive gases used in the measurement of lung function (Matthews and Dollery, 1964). It also has the advantage that the interchange of materials between compartments of the body can still be simulated even when the size of the compartments is changing, since it is not necessary to assume dynamic equilibrium, and a computer has been used to interpret results of experiments with ^{131}I-labelled plasma proteins under these conditions (Matthews, 1965).

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In several fields computers have already established themselves as standard pieces of routine apparatus. In radiotherapy departments they have begun to relieve hospital physicists of the calculation of the more complex dosage schedules, and in departments of chemical pathology they complete the work of automatic analysers by converting tracings into numerical measurements. In departments of statistics they are replacing the desk calculating machine, and they are becoming the normal tool for simulating biological models in departments of physiology. After a preliminary period in the hands of the research worker their use will, in all probability, extend widely into other fields. The uses that have been cited represent only some of the more outstanding ways in which they are beginning to be applied and many others might be quoted. Whatever the application, the development of the computer provides a challenge to doctors to record their observations quantitatively, systematically and in generally acceptable and precise terms, so that their accumulated experience may be used as a basis for future diagnosis and prognosis.

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PROGRESS AND PROSPECTS IN CANCER RESEARCH

So far as this country is concerned, experimental cancer research is essentially an affair of the 20th century. About the turn of the century the view appeared to develop that little further advance could be hoped for at that time from the purely clinical or pathological approach or from the study of cell morphology, even though these had been earlier pursued with classical success in Britain, on the Continent and elsewhere. The need for greater application of the experimental method was reflected in this country in the establishment of the Imperial Cancer Research Fund in 1902 and the Research Institute of the Royal Cancer Hospital in 1909. Similar developments were taking place in Europe, the United States and Japan. As a result great work was done. To take but one example, in the ten years before the First World War Bashford and his small but remarkable team at the Imperial Cancer Research Fund Laboratory helped to lay the foundations of modern cancer research with their studies of the zoological distribution of cancer and the biological characteristics of animal tumours and their behaviour in serial transplantation; they even laid the foundations of tumour immunology.

Naturally there were mistakes and disappointments. There is evidence, for example, that many of the earlier workers, including Bashford himself, were over-sanguine; the achievements of nineteenth-century bacteriology had been such that these men were quite reasonably encouraged to look forward to a fairly speedy solution of the cancer problem. Moreover, apart from scientific misjudgments, it is now apparent that the scale of effort in cancer research was too restricted to offer much hope of progress; the British Empire Cancer Campaign, for instance, over the 30-year period from its foundation in 1923, spent no more than £1·5 million. Of course, the problem of cancer cannot be solved merely by the expenditure of more money, but it is undeniable that

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greater investment in men and in facilities has proved to be necessary than was contemplated in the early days. At the present time there is abundance of ideas, originating from many scientific disciplines, and the main problem facing those who direct cancer research is to select, within their available resources, those ideas that offer real promise of advance.

The problem

The attempt to explain malignant growth has been called the biological analogue of squaring the circle and a good case could indeed be argued that it is doomed to failure. We recognize in cancer a profound cellular transformation to which any dividing cell appears to be liable; this transformation involves the loss of the property of cell differentiation, which is the basis of normal growth and development. The problem of cancer is therefore one of fundamental biology rather than of a pathological process, and it is as such that it must be viewed if the attack upon it is to be effective.

Looked at in this way, cancer research becomes a formidable undertaking indeed, but not one in which we need despair of success. The current explosion of biological research at the molecular level and the results that have been achieved are sufficient encouragement, but the advances in molecular biology are at the same time a demonstration of the outstanding need of research on cancer, namely that it must be conducted on a broad scientific front; the problems of malignant growth, like those of molecular biology, will require for their solution not only biological knowledge and techniques but also the application of the concepts and the methods of chemistry, biochemistry and physics, branches of science that will themselves in turn certainly benefit from the efforts of cancer research workers.

It follows from this that cancer research is much influenced by the continuing and revolutionary advances in technology and technical precision. One example may suffice. Sir Ernest Kennaway and his group spent several years in the late nineteen-twenties and early nineteen-thirties in laborious, ingenious and eventually successful efforts to isolate a small quantity of 3, 4-benzpyrene from some 2 tons of pitch (in which we now know benzpyrene may occur in rather large amounts); today with a minute quantity of starting material the whole operation could be completed in the course of a single afternoon.

CHEMOTHERAPY

In this review of the present state of cancer research chemotherapy is considered first for a special reason which will appear later. Many believe that the ultimate control of cancer will be based not on surgery or radiotherapy but on the exploitation of some chemical, enzymatic or immunological principle. At the present time, when chemotherapy is still in its infancy, a score or two of chemical agents are available with important if distinctly limited ameliorating effects on malignant disease. It must, however, be stressed that their use requires expert clinical and laboratory control.

The agents include many chemical types, for instance a variety of steroids, antimetabolites (which interfere with the normal formation of essential substances such as folic acid or nucleic acids), many alkylating agents based upon the sulphur and nitrogen mustards, and certain natural products (such as the periwinkle alkaloids vinblastin and vincristin). These were discussed in an

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article on the chemotherapy of cancer in the Council's last Annual Report (Medical Research Council, 1964). At the Chester Beatty Research Institute a number of aromatic alkylating agents, such as chlorambucil and melphalan, have been developed during the past fifteen years. Melphalan, a derivative of aminophenylalanine, is occasionally capable of inducing spectacular improvement in multiple myeloma (a tumour arising in the bone marrow); but perhaps the most satisfactory agent has been Myleran (of the dimethane-sulphonyl-oxyalkane series), which when carefully administered at a dosage of a very few milligrams daily can induce favourable responses in chronic myeloid leukaemia —often for very long periods—without causing side-effects, and is probably the chemotherapeutic agent of choice in the treatment of this disease. It is at the moment the subject of a clinical trial under the aegis of the Council, being compared with radiotherapy for the treatment of chronic myeloid leukaemia.

None of the agents mentioned is capable of eradicating the disease, and all suffer from serious disadvantages, whether lack of specificity—no compound is known that attacks malignant tissue without affecting normal cells also—or the induction of drug-resistance; hence none provides a radical solution, or is likely to have any long-term future in the treatment of cancer. On the other hand—and this is the reason for dealing with them first—many of these chemotherapeutic agents, particularly the alkylating agents, provide unique insights into the fundamental chemical and biological processes of cells. They have been described as molecular spanners, which can be dropped into the cell machinery and can then send back messages about its innermost secrets. It is through the experimental use of such agents that entirely new principles will emerge, which will render the agents themselves obsolete so far as their application in therapy is concerned.

EXPERIMENTAL CARCINOGENESIS

Manifold as are the methods of attack on the cancer problem the induction of cancer in experimental animals is central to them all. Progress in our understanding of carcinogenesis since the last war can well be illustrated by comparing the three issues of the *British Medical Bulletin* that have been specially devoted to it. The first appeared in 1947 and provided a conspectus of the situation at that date, already reflecting the marked expansion of cancer research that had started immediately after the war. The second issue came in 1958, and the third in May 1964; this latter differed from its predecessors in its wider scope, embracing as it did not only chemical but also viral carcinogenesis. It thus reflected the great changes in the scale and tempo of research which had occurred in less than a decade.

Thirty years ago it seemed possible that the only chemical carcinogens—or the main ones—were the polycyclic hydrocarbons. These are present in such substances as tars and mineral oils, once notorious sources of skin cancer in industrial workers; but traces of many powerful carcinogenic hydrocarbons can also be derived from natural steroids (which include certain hormones) as a result of deviations in metabolism: there is ample evidence that such deviations can be made to occur in the laboratory and it is practically certain, though there is as yet no proof, that they can occur in the living organism. However, a wide range of other chemical types, very different from the hydrocarbons, are now known to be capable of evoking malignant disease; as examples may be cited

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the carcinogenic amines and the nitroso compounds, the carcinogenicity of the latter group having been discovered in the Council's Toxicology Research Unit by Magee and Barnes (1956).

The most striking feature of the carcinogens—chemical, physical and viral—is their diversity. It is certain that they must operate by biochemical routes that are initially very different. Yet in spite of this it is still possible that they may induce the same kind of cellular transformation, and the same ultimate key event within the cell. There appears no reason why the nature of this transformation should not eventually be comprehended, and the essential differences discovered between normal and cancer cells at the level of the chromosomes and their constituent molecules.

Chemical carcinogens

Although the state of cancer research at the present time is encouraging and exciting—perhaps more so than ever before—the prospects must not be overstated. Progress in the elucidation of mechanisms of the different types of carcinogens has varied greatly, and it is humbling to reflect that so little is known of the mode of action of even the carcinogenic hydrocarbons. From thirty years of work by Sir Ernest Kennaway and his school a beautifully clear and satisfying relationship was found, for many hydrocarbon series based upon the parent phenanthrene, between certain features of chemical constitution and carcinogenic action. However, the relationship did not in itself elucidate the mechanism of action, except perhaps to suggest that this probably depended on a specialized kind of chemical reactivity, at that time undefined. The next stage was an extensive search to determine which features of the rather mysterious and sluggish hydrocarbon molecules were of greatest significance in the biological action. Here important ideas came from Sir Robert Robinson and from the French schools of theoretical physics on the importance of the reactive 9, 10-phenanthrene double bond. It had long been realized that there was a possibility of reaction between the hydrocarbons and the nucleic acids of the cell nucleus, and it was known that these otherwise highly insoluble compounds became soluble when they formed complexes with many purines and nucleic acids. Recently these notions have led to great interest in the possibility that hydrocarbon molecules become inserted between adjoining base pairs of nucleotides in the DNA of the chromosomes, with the result that the genetic ' instructions ' encoded in the DNA are changed and malignant transformation is initiated; but there is as yet no experimental evidence to support this hypothesis.

During the past fifteen years, further advances have been made in understanding the mode of action of the alkylating carcinogens—that is, mustards, epoxides, ethyleneimines, lactones and many others (Brookes and Lawley, 1964). Alkylating agents are highly reactive with many chemical groups that occur in living cells, and the advantages of using them for the study of carcinogenic mechanisms rest in their chemical simplicity, in the ease with which their structure may be modified, and in the clear dependence of carcinogenic activity upon a certain minimum threshold of chemical reactivity. Most important, carcinogenic action appears to be associated most strongly with those agents that have two reactive groups and are thus able to form bridges between two different molecules; this cross-linking effect was recognized by Goldacre, Loveless and Ross as long ago as 1949. The sites involved in cross-linkage were then unknown, although they were suspected to reside within the nucleus, most probably

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in the chemical structure of the chromosome itself (Brookes and Lawley, 1961; Lawley and Brookes, 1963). The latest in a long series of discoveries is that of Lawley, who showed that in the alkylation of guanylic acid, reaction occurred specifically at position 7 of guanine, and the finding of Brookes and Lawley that bisguanyl compounds are formed by the alkylation of DNA: although formal proof is not yet available, it is virtually certain that the cross-linking process involves the twin strands of the DNA helix itself, thus interfering with the separation of the strands and consequently with cell division (figure 1). The implications of these hypotheses are only beginning to be explored, but it

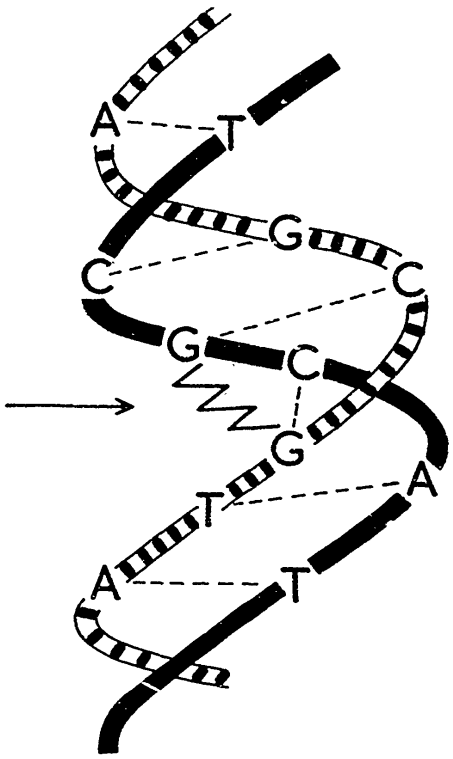

Figure 1

The inter-strand cross-linking of DNA by bifunctional alkylating agents. (From Brookes and Lawley, 1964.)

G = guanine C = cytosine
A = adenine T = thymine

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would seem that a deletion occurs, or some alteration in the base sequence, resulting in a change in the cell's genetic potential and thus in the substances synthesized according to the instructions of the DNA. In other words, these advances go far to confirm what had long been suspected, namely that the fundamental change in malignancy is mutation.

Alkylating properties are also apparent in many other classes of carcinogen, for example the nitroso compounds of Magee and Barnes (in which may be included the methylnitrosourea of Druckrey—see review by Magee and Schoental in the British Medical Bulletin of May 1964—which is capable of inducing leukaemia and cerebral tumours), and the lactones studied by Dickens and his colleagues at the Middlesex Hospital (Dickens and Jones, 1961). It is astonishing

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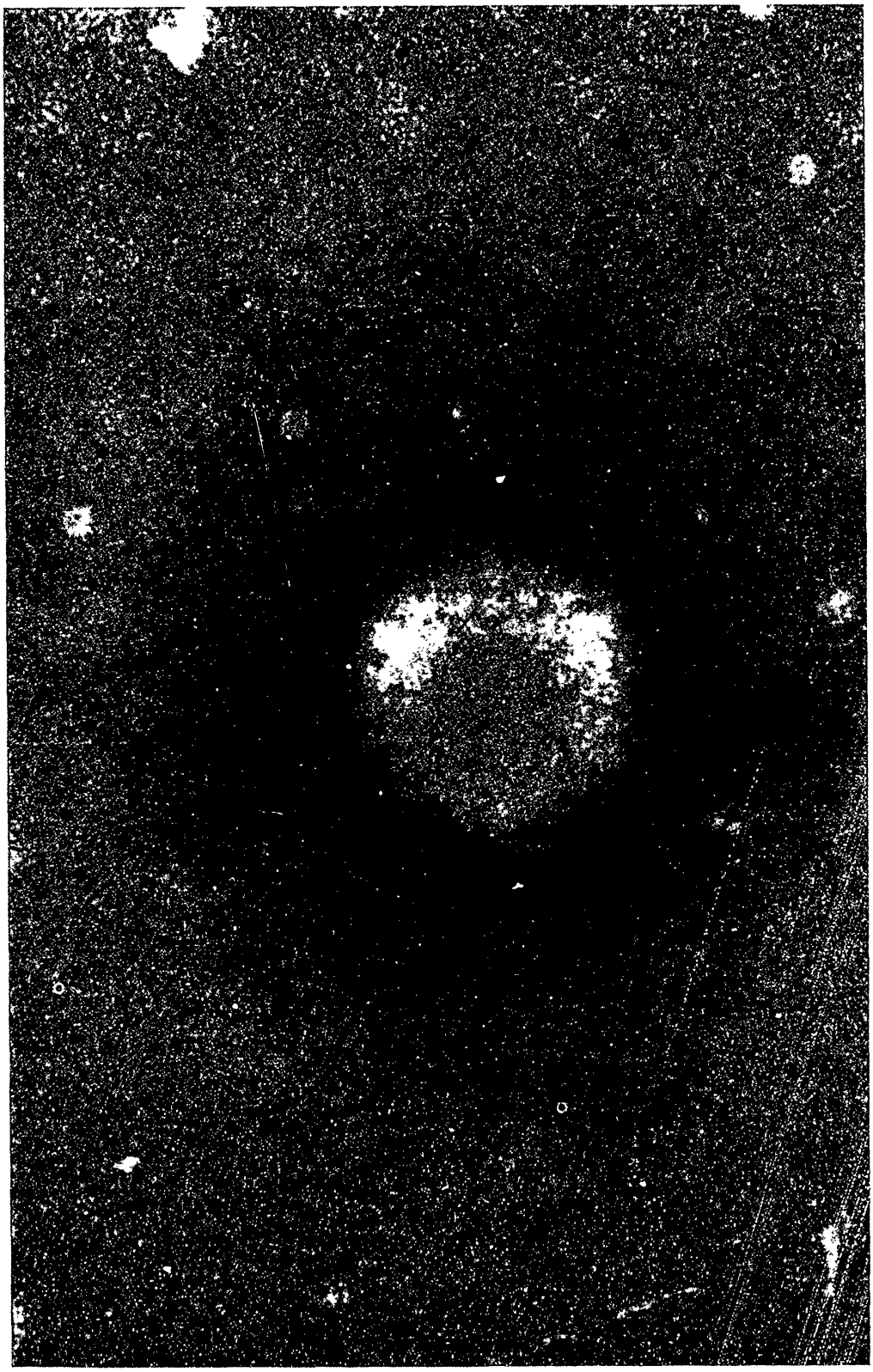
PLATE I



Electronmicrograph of adenovirus 5 (× 500 000)—see p. 3.

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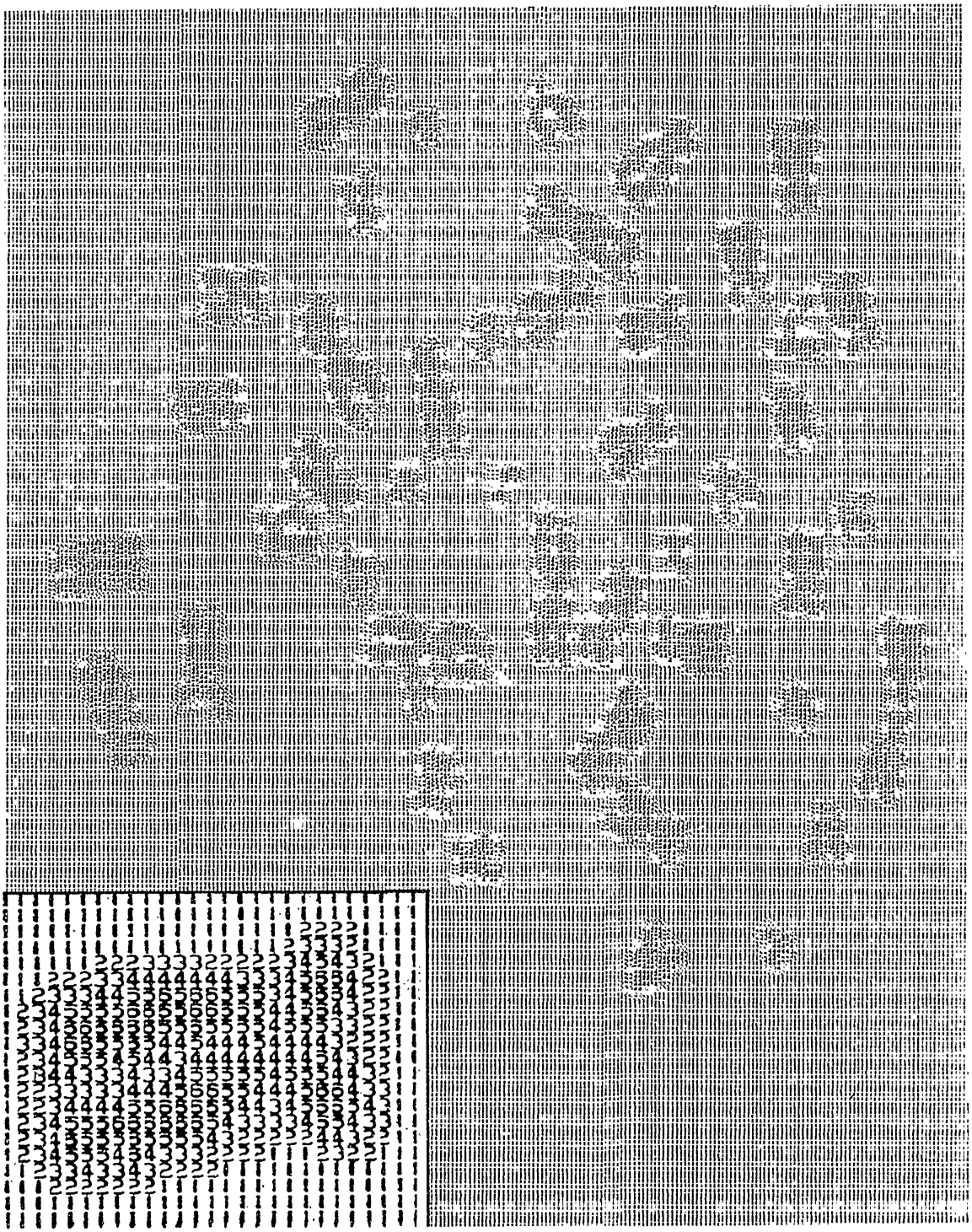
PLATE II



Representation of chromosome photomicrograph (Plate III) in the computer's memory: actual computer print-out (with detail inset) of picture that has been put into the computer's memory in 0·2 sec by the scanning device FIDAC. From Ledley (1964).

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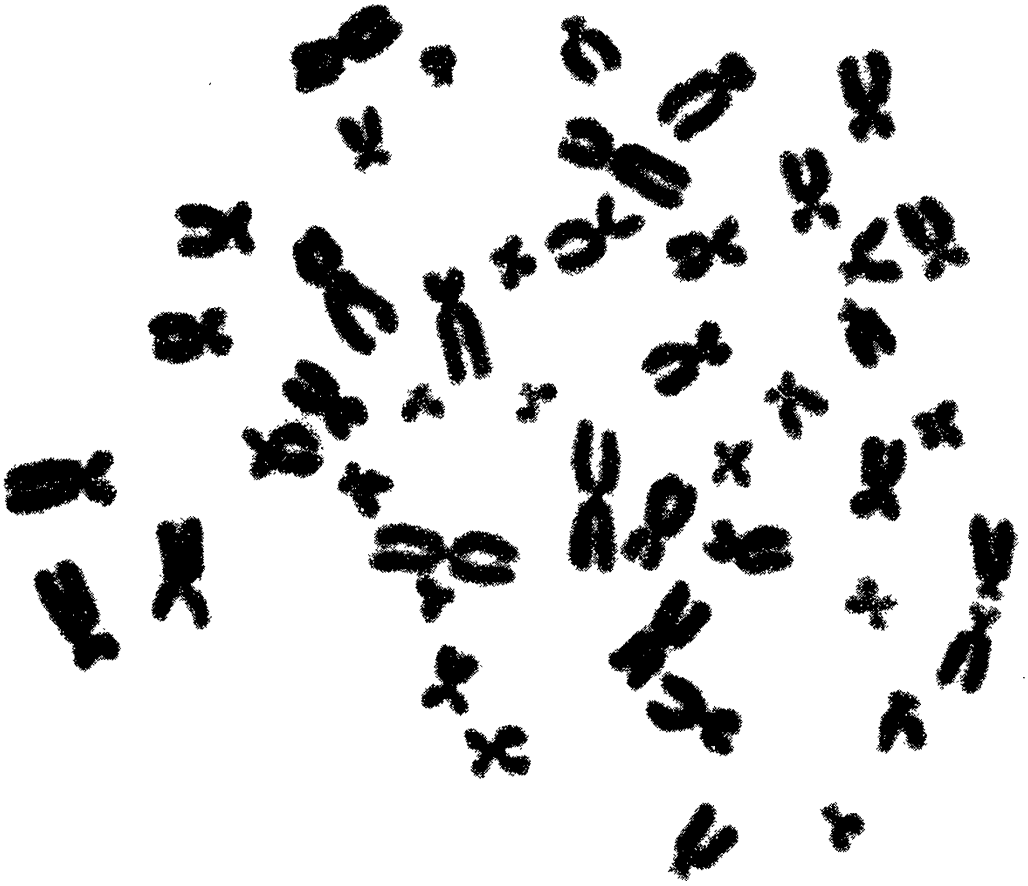
PLATE III



The original chromosome photomicrograph processed by FIDAC. From Ledley (1964).
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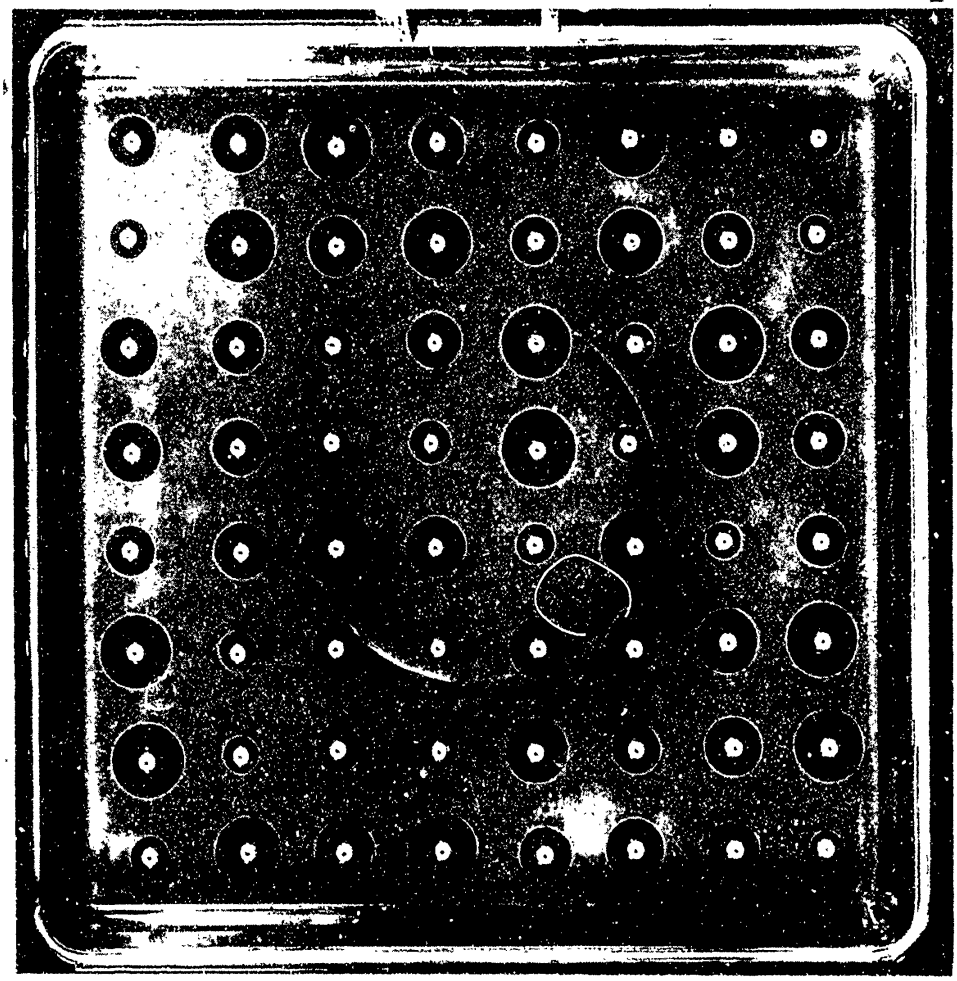
PLATE IV



A fibrin agarose assay plate after 16 hours' incubation at 37°C. The white circles are cups of activator and the dark rings surrounding them are areas where the fibrinogen has been digested.

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to reflect that the study of alkylating agents was initiated as long ago as the end of the last century—by Paul Ehrlich, who believed ethyleneimine to be unique amongst the many hundreds of compounds he had examined in its capacity to induce irreversible changes in what was then called protoplasm.

Natural carcinogens

An increasing number of so-called natural carcinogens are being discovered. These include parasorbic acid (found in the mountain ash berry and widely distributed in plant tissues and perhaps in animal tissues also), which has been found to cause malignant tumours at the site of injection in rats, and the carcinogenic aflatoxins of ground-nuts infected with the mould *Aspergillus flavus;* the latter produces a disease mostly affecting the liver, which in 1960 was responsible for the death of some 100 000 young turkeys that had been fed with infected ground-nut meal. Japanese rice mouldy with *Penicillium islandicum* is another liver carcinogen, as are also many plant toxins (including the *Senecio* alkaloids) and many vegetable tannins.

Physical carcinogens

In the realm of physical carcinogens films of cellophane and a great range of plastics may be mentioned. These materials are active when implanted in the subcutaneous tissues even though some if not all of them are probably chemically inert. In such cases the mechanism of carcinogenesis must be physical, and there is evidence that the film may simply interrupt the local capillary blood supply; this would induce local anoxia in the tissue and so produce an environment in which malignant change is triggered off at a critical point. Better known are the carcinogenic effects of ultraviolet irradiation and of ionizing radiations. There are two recent conclusions on the subject of the hazard of ionizing radiations for man. First, the latest data of the Atomic Bomb Casualty Commission indicate a general increase in malignant disease among the most heavily irradiated of the survivors of the Hiroshima and Nagasaki explosions, the most marked increase being in the incidence of leukaemia (Harada *et al.*, 1963; Jablon, Ishida and Yamasaki, 1963). Secondly, there appears to be a very slight but probably real increase in the incidence of leukaemia in children following prenatal X-irradiation (Stewart *et al.*, 1956).

Tumour viruses

Finally we come to the so-called oncogenic (tumour-producing) viruses. Like other viruses, these contain either RNA or DNA, and such classical examples as the Rous, Shope papilloma and Bittner viruses illustrate how diverse are the physical, chemical and biological properties of viruses with carcinogenic potentiality. The story of the Gross leukaemia virus is a fascinating one—a devoted worker, after failing for many years to produce leukaemia in young mice by inoculation of cell-free extracts from leukaemic mice, was eventually led to test his materials in newborn animals (see Gross, 1961). Large numbers of experiments then provided evidence that the disease was indeed transmitted by a viral agent. This was a key discovery, and it soon led, in the hands of Stewart, Eddy and others, to the revelation of the polyoma virus, which caused multiple tumours in the neck and elsewhere and was shown to co-exist alongside leukaemia virus in the filtrates obtained from leukaemic mice (Stewart and Eddy, 1959).

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There are two peculiarities of tumour production by viruses—first, the very large quantities of certain DNA viruses required to effect cellular transformation and, secondly, the fact that in some cases the virus probably induces more or less instant change in the gene complex and then disappears, whereas in other cases there is evidence that viruses or virus particles persist indefinitely in the malignant cells. What is the relevance of these findings for cancer in man? It could be little or it could be all. Direct evidence is lacking, but there are two vital observations: human cells in tissue culture can be transformed by the simian virus SV40 (Koprowski *et al.*, 1962), while adenovirus 12, which is commonly found in the human respiratory tract, can induce cancer in the hamster (Trentin, Yabe and Taylor, 1962).

A great stimulus to the study of cancer viruses has resulted from recognition of the Central African lymphoma or Burkitt tumour that occurs in African children, frequently affecting the jaw (Burkitt, 1962). Here is a syndrome confined to geographical areas rather than to races or tribes, and with an incidence related to altitude, latitude and rainfall. All this suggests an aetiological route via an arthropod-borne agent, conceivably of viral nature; the fact that the disease affects children suggests that it may represent a natural example of the principle demonstrated experimentally by Gross in infant mice—namely, that infection by the virus or other agent causes malignant transformation only when it occurs soon after birth. The search for a definite virus has so far had negative or inconclusive results, but it continues intensively.

Recently, Negroni and others at the laboratories of the Imperial Cancer Research Fund have adduced evidence for the growth in tissue culture of viral or plasmal agents from the bone marrow in ten out of twenty-five cases of human leukaemia; these agents were shown to be related to each other, and electron microscopy demonstrated that the particles were structurally similar to the known leukaemia viruses found in mice and birds (Negroni, 1964; Inman, Woods and Negroni, 1964). There can be no doubt of the observations themselves, but interpretation is extremely difficult, as Negroni himself was the first to emphasize: the agents were not seen in the bone marrow of any subjects without leukaemia, but the number of these control observations was too small to prove an exclusive association with leukaemia, and it is possible that the particles observed were merely ' passenger ' organisms rather than causative agents. Meanwhile certain results obtained by Grist and Fallon (1964) among others suggest that the agent described by Negroni is not a virus but a mycoplasma (a pleuropneumonia-like organism), though they do not preclude the possibility that both are present.

THE MECHANISM OF CARCINOGENESIS

It is conceivable, if improbable, that chemical and physical carcinogens operate by activation of latent oncogenic viruses. More probably all such agents, by their devious routes, induce changes in the genetic material that are identical in principle—some chemical carcinogens acting directly on the DNA of the cell, DNA viruses (by taking on the role of the cellular DNA) perhaps transcribing ' wrong ' information on to the messenger RNA (which will thus form a new template for the synthesis of proteins), and RNA viruses possibly acting directly on the messenger itself. In spite of all our deficiencies in knowledge, it seems that we are now in prospect of a comprehensive understanding of the means of action of chemical, physical and viral carcinogens.

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The carcinogenic process has been described (by Heidelberger, 1959) as a mirror in which each man may see his own image reflected: that is, different workers may describe and interpret it independently in the languages say of chemistry, genetics, virology and immunology. The process should perhaps rather be regarded as involving the impact of any one of a host of reagents—whether micromolecular, macromolecular or viral—upon the integrity of the cell's gene complex. We begin to understand the multi-stage character of the process, the first stage being an irreversible chemical interaction of the carcinogen with hitherto inviolate genetic receptors. This event itself is silent, and only gains expression from so-called ' promoting ' processes, among which cellular proliferation is probably necessary, though it may not be a sufficient cause—in other words, the affected cell may require to undergo division before malignant transformation is complete.

What is the outcome? From altogether different approaches, workers in different parts of the world have reached the same, almost certain, conclusion—that the key event in the carcinogenic process is biochemical deletion. More than thirty years ago, J. A. Murray, then Director of the Imperial Cancer Research Fund, stressed that the malignant cell has not *acquired* the property of unlimited growth, since this is already a property of the normal cell; rather it has lost the mechanism of control which operates so beautifully in the normal cell. We have known for many decades of structural and functional results of deletion but are still largely ignorant of its biochemistry, although most certainly this involves the inbuilt enzymatic controls of the growth potential of the normal cell. For too long we have made biochemical and other comparisons between the cancer cell and the corresponding normal adult cell. But the comparison is wrong and misleading, and should rather be between the cancer cell and the embryonic cell, or perhaps the trophoblast (the rapidly growing and temporarily invasive normal tissue that attaches the ovum to the uterine wall). A century ago German pathologists were struck by the resemblance between the cancer cell and the embryonic cell, and in spite of the enormous amount of work which has since been completed this still perhaps appears as the salient fact in the cancer process.

Although biochemical deletion has an overwhelming importance, nevertheless —as so often happens—the situation is not simple. We now have unequivocal evidence also that in both chemically induced and in virus tumours there may be a potentiation or reinforcement of individual enzymes and other proteins that act as antigens, and further that new antigens may develop—which in theory at least should be capable, as ' foreign ' proteins, of evoking immunological defence reactions against themselves. Figure 2 illustrates the pattern of loss, modification and gain of certain proteins in liver cancer produced by azo-dye in the rat, showing the contrast in distribution in the normal liver and in three tumours. It is of intriguing interest that where tumours have been induced by a chemical compound, the new (' tumour-specific ') antigens contained in them tend to be different in different tumours, with relatively little cross-reaction between them, while tumours evoked by a given virus usually possess an antigen common to them all (Haddow, 1965).

In part it is the discovery of characteristic antigens in tumours that has led to the current revival of tumour immunology. The fact that cancer cells are able to proliferate is evidence that immunological non-recognition of such cells

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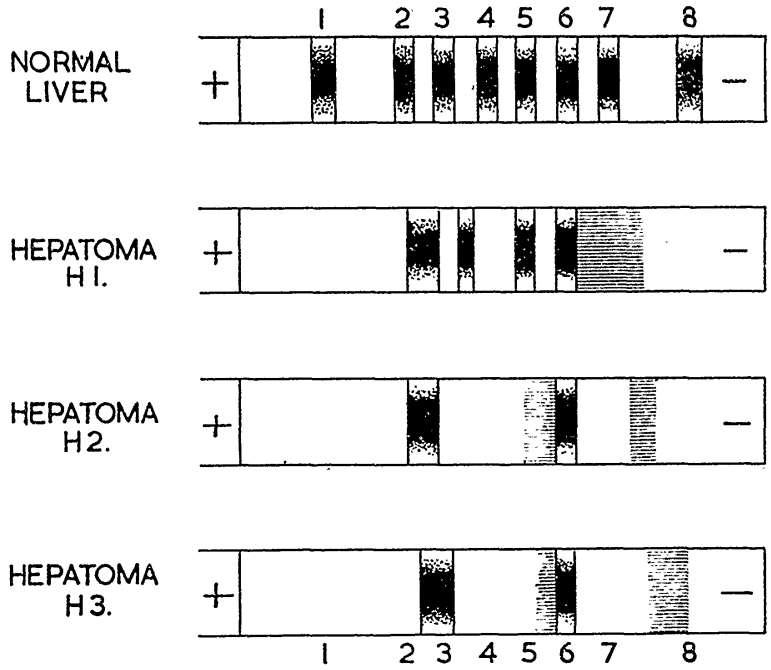

Figure 2

Position of eight proteins in normal rat liver after electrophoresis on starch gel, compared with the pattern in three azo-dye-induced hepatomas showing deletion, modification and gain of proteins. The shaded areas represent weaker, less distinct bands. (See Whitcutt and Elson, 1962.)

is the rule; but on the other hand a flicker of recognition may sometimes appear—this is suggested by the fact that on occasion primary chemically induced tumours may regress after they have been grafted on to another site in the same animal. Even if immunology were to have no practical application in the future treatment of cancer, it has already had a prodigious influence on our comprehension of carcinogenesis and the cancer cell. What is now required is an integration of immunology and differentiation biology. The central question is whether the cancer cell, known to be dedifferentiated in so many ways, is susceptible or not to redifferentiation. If so, to what extent can the chemical forces of normal differentiation be brought to bear upon it? In a recent paper, Sachs (1964) states his belief that the prospects are bright, and that the regulatory mechanisms which control cell differentiation in multicellular organisms may, in the not too distant future, cease to be one of the main unknown areas of biology. At least this is the direction in which attack must surely move.

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PROGRESS IN RESEARCH ON COLDS

In the Council's Annual Report for 1959–60 a preliminary account was given of the successful isolation and cultivation by workers in the Common Cold Research Unit at Salisbury of viruses from nasal washings of individuals suffering from common colds. This success, which followed 12 years of continuing effort, was achieved by inoculating the nasal washings into cultures of human embryonic kidney cells maintained under carefully defined conditions of temperature and acidity of the culture medium; the virus multiplied, causing pathological changes in the cells of the culture, and it could subsequently be recovered and shown to be capable of producing colds in normal human volunteers. Thus the virus could reasonably be assumed to be the causative agent of the illness.

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The discovery of a method for the cultivation of the common cold virus had been the primary objective of the Unit's work, because such a method was the essential preliminary to laboratory and clinical studies, which might lead to understanding of the mode of natural infection, the epidemiology of the disease and, perhaps, ultimately a means of prevention. During the past few years studies on these lines have been actively pursued in this and many other countries, and the time is opportune to review the knowledge that has been obtained.

Isolation and cultivation of some common cold viruses

At first the progress of work on the newly isolated viruses was hampered by the apparent need to use human embryonic kidney cells, which are available only intermittently and in small amount. The possibilities were somewhat enlarged when it was found that some of the viruses isolated would also grow in monkey kidney cells, but the greatest advance in technique came with the development of cultures of lines of human cells by Hayflick and Moorhead (1961); these are fibroblast cells derived from human embryo lung, which can be easily grown in culture and which can be subcultured up to 40 times without seeming to lose their normal biological characteristics. Certain strains of these cells are highly susceptible to infection by common cold viruses; they may be used for the cultivation and study of viruses that have been isolated in human embryonic or monkey kidney cells, and they may also themselves be used directly for the isolation of viruses from the nasal washings of persons suffering from colds.

By the use of these cell cultures, viruses conforming in properties to those originally isolated at Salisbury have been detected in persons suffering from common colds in many different laboratories (see for example Hamre and Procknow, 1961; Hamparian, Ketler and Hilleman, 1961; Johnson *et al.*, 1962; Hobson and Schild, 1960; Higgins, Ellis and Boston, 1963). They have occasionally been isolated from individuals not at the time suffering from colds and from children with bronchitis; in the latter case, however, there is no proof yet that the virus is the cause of the serious respiratory disease (MRC Working Party on Acute Respiratory Virus Diseases, 1965). The ability of these viruses to produce colds in normal volunteers under controlled conditions is not in itself a rigorous proof that they cause colds under natural conditions; the supposition that they actually do so is, however, strongly supported by the fact that they are found in the noses of persons suffering from a common cold about 10 times as frequently as they are in the noses of persons without colds.

Physical and chemical properties of the newly discovered common cold viruses

The study of these common cold viruses by ultrafiltration and ultracentrifugation has shown that the particles are closely similar in size and density to those of poliovirus. They also resemble poliovirus and other enteroviruses such as coxsackieviruses and echoviruses in that they contain ribonucleic acid; in at least one common cold virus the ribonucleic acid has been shown to be infective and there is no reason to suppose that this is not true of others, as it is of enteroviruses. A further property shared by common cold viruses and enteroviruses is that of stability towards ether. On the other hand, these common cold viruses can be sharply distinguished from enteroviruses in two respects, namely their sensitivity to acid and their natural habitat. Common cold viruses rapidly lose their infectivity in mildly acid media (pH 3–5), in which enteroviruses

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are quite stable; common cold viruses have been isolated almost exclusively from the nose, whilst enteroviruses inhabit the alimentary tract. The general characteristics of the common cold viruses have been summarized by Tyrrell and Chanock (1963).

Classification and immunology of rhinoviruses

For the purpose of classifying viruses account is taken of the main similarities and differences in physical and chemical properties and in biological behaviour; on these grounds the common cold viruses so far discussed are seen to be clearly related to the enteroviruses but different from them. A comprehensive name, ' picornaviruses '*, has been coined to embrace all the small ribonucleic-acid-containing viruses, and within this family the common cold viruses have been specifically designated ' rhinoviruses ' in recognition of their natural habitat.

The existence of subtle differences between individual viruses within a group can be revealed by immunological means. In common with other viruses, rhinoviruses give rise to the formation of antibodies, which appear in the blood of an infected individual or which may be produced in the blood of an animal injected with the virus; various immunological reactions between the antibody and the virus that has given rise to its formation can be examined outside the body and are highly specific. Studies of this kind have shown that among the common cold viruses that have been isolated a number of different strains exist that are indistinguishable from one another by physical and chemical analysis but are distinctive in their immunological reactions; such strains are designated ' serotypes '.

The existence of different serotypes of an infective organism has an important bearing on the acquisition of natural immunity against infection and on the possibility of producing artificial immunity by the use of a prophylactic vaccine. A survey is therefore being made, largely through reference laboratories of the World Health Organization, of the serotypes of viruses isolated from patients with common colds in widely separated parts of the world. It is believed that at least 30 such serotypes exist; the rhinoviruses thus clearly comprise a large family of closely related strains of virus.

Resistance to infection with rhinoviruses

The fact that there is a definite relationship between the presence or absence of specific antibody in the circulating blood and susceptibility to infection by rhinovirus has been clearly demonstrated in an investigation by Bynoe *et al.* (1961). In this experiment a single strain of rhinovirus was inoculated intranasally into a number of volunteers; some of these already had antibody in their blood (presumably owing to an earlier infection) whilst others did not. The percentage of colds produced was higher in those volunteers with no pre-existing antibody, and in those who got colds antibody appeared in the blood or increased in amount as the result of the infection. These results have been confirmed with four other strains of rhinovirus and they provide presumptive evidence that prophylactic immunization against rhinovirus infection should be possible.

In preliminary experiments on the possibility of protection, rhinovirus adapted to growth in tissue culture (and therefore likely to be attenuated in virulence) has been inoculated into volunteers by three different routes (Doggett, Bynoe and

* I.e. pico-RNA-viruses

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Tyrrell, 1963). When given intranasally it elicited antibody responses but at the cost of a mild cold; given by mouth it had no effect of any kind. A more hopeful observation was that when given intramuscularly it elicited a good antibody response without producing symptoms of a cold. Such a vaccine has been shown to protect volunteers against colds produced by experimental inoculation with rhinovirus of the same serotype. There was no protection against infection by a serologically distinct virus.

The problem of vaccination against rhinovirus infections is obviously complicated by the existence of a multiplicity of strains of the virus; if all the strains were equally prevalent and each differed widely from the other in immunological specificity, the problem would indeed be practically insoluble. It may well be, however, that some strains predominate both in the frequency of their occurrence and in the broadness of the antibody response that they elicit. Two strains of rhinovirus are indeed known that have been found to be related by laboratory tests, and vaccination with one of these elicits formation of antibody against both; it is more common, however, to find little relationship between viruses by laboratory tests.

The final answer to the question of the feasibility of vaccination against rhinovirus infection must await the results of much further work. In the meantime, however, the Council are collaborating with three British pharmaceutical firms in research on methods of producing purified and concentrated vaccine preparations containing several strains of rhinovirus, which will be examined for their protective effect.

Respiratory infection by other viruses

By strict definition, the common cold is an upper respiratory infection, usually afebrile, and associated particularly with nasal congestion and discharge. If we adhere to this definition it seems probable that rhinoviruses are the most important cause of the syndrome. There was until recently a proportion of cases of common cold that were atypical in that no virus could be isolated from the nasal washings in cell or tissue cultures normally used for the isolation of rhinoviruses, although these washings produced colds in normal volunteers. It has now been found that organ cultures of human embryonic trachea will support the growth of all viruses so far identified as causes of upper respiratory disease in man, and with the aid of such cultures virus has also been isolated from the atypical cases. The organ cultures differ from the cultures previously used in that ciliated surface cells are present and active; this suggests that the viruses responsible for the atypical cases may be able to grow only in cells of this type. Some of these new viruses are rhinoviruses but at least one is not. (Tyrrell and Bynoe, 1965.)

Common colds are only part of the range of minor upper respiratory infections that is observed in clinical practice. Some of these infections are more severe than are colds and may be accompanied by fever, sore throat, or some involvement of the lower respiratory tract. Much work has been done during the past few years on this group of infections; in particular a collaborative investigation has been undertaken by the MRC Working Party on Acute Respiratory Virus Diseases (1965) to ascertain the relative importance, in various environments in the United Kingdom, of all the viruses known to be capable of producing ' colds ' and to obtain more information about the natural history of the various infective agents. It appears that in about one-third of such cases one of a

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variety of viruses may be isolated, including influenza and parainfluenza viruses, adenoviruses, enteroviruses and respiratory syncytial virus; β-haemolytic streptococci may also be found. Each organism may be detected from time to time in conditions ranging from common colds to bronchitis; but it is clear that while certain agents such as the adenoviruses, enteroviruses and streptococci account for many cases of sore throat, rhinoviruses and to a lesser extent parainfluenza viruses and respiratory syncytial virus play an important part in the causation of illness with the clinical characteristics of common colds. The results already obtained suggest that rhinovirus infections tend to occur in waves in the autumn and spring, whilst the prevalence of upper respiratory infections due to other viruses varies from year to year.

In addition, workers in the WHO Reference Laboratory at Salisbury have examined sera obtained from adults (not ill at the time) living in every continent and have obtained evidence of earlier infection not only with rhinoviruses but with many of these other viruses, by the demonstration of the presence of antibodies; it thus seems likely that the causes of acute respiratory infections may be the same all over the world—a view which is supported by the fact that students coming to Britain from the tropics have no more colds than do those who have lived here all their lives (MRC Committee on the Aetiology of Chronic Bronchitis, 1964).

The spread of colds

The possibility of cultivating cold viruses in the laboratory opens the way to re-investigation of their dissemination under natural conditions (Buckland, Bynoe and Tyrrell, 1965). A useful model for this purpose is coxsackievirus A21, an enterovirus which causes illnesses of the common cold type. When an individual is infected with this agent much of the virus is found in the nose and little in the saliva; it is thus shed mainly by sneezing and by blowing the nose rather than by talking. Most of what is shed is contained in coarse drops, which quickly fall out of the air and in which the virus soon dies. A little of the virus is, however, found in small droplets of 4–20 μ in diameter and these may find their way into the nose of an uninfected individual; a single tissue culture dose of virus inhaled in this way is sufficient to produce a cold. The number of droplets produced by a sneeze varies somewhat from one individual to another and the concentration of virus in nasal secretion varies enormously—up to a million-fold. Only when this concentration is very high can virus be recovered from the small airborne droplets produced by sneezing; the fact that epidemics due to this particular virus tend to occur in rather large and crowded communities suggests that only a fraction of infected individuals have enough virus in the nose to produce infectious droplets at all frequently.

It is hoped that continuation of studies of the kind described in this article will tell us what illness is produced in each year by the various causative viruses in different environments (such as factories, schools and hospitals), and enable us to define more precisely the nature of the illness produced by each infective agent and the means by which it is spread. It is only through information of this kind that we can hope to derive a better understanding of the very complex aetiology of these diseases and thus to develop means of preventing them.

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BIOLOGICAL STANDARDS

It is now 43 years since Banting and Best showed that it was possible to prepare extracts of pancreas that had the power of reducing the level of the blood sugar and could be used in the treatment of diabetes. The active principle (insulin) responsible for the physiological effect is present only in small amounts in the crude pancreatic extracts; the amounts vary between one batch of extract and another, and the only means of assessing them was to measure the reduction in the blood sugar of animals after the administration of a known quantity of an extract. Animals, however, are not all equally sensitive to drugs, and measurements of this kind, expressed in terms of the degree of response in animals, were inevitably inaccurate and could lead to overdosage or underdosage with insulin, either of which might prove dangerous. Here therefore was a problem in urgent need of solution.

Since the intrinsic variability of animal response precluded the use of a single physiological test (or bioassay) in isolation as an accurate measurement of the amount of insulin present in a pancreatic extract, the first requirement was to devise a procedure from which the variable factor was eliminated. This could only be achieved if there were available a standard preparation of pancreatic extract containing insulin against which preparations of unknown insulin content could be directly compared, weight for weight, by appropriate physiological test. By international agreement therefore such a standard was prepared in the form of a bulk preparation of crude insulin, the unit of insulin activity being defined as the amount of activity contained in a stated weight of this

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standard. The insulin content of a batch of any pancreatic extract could then be determined, and expressed in units of insulin activity, by submitting known weights of it to physiological test in direct comparison, under identical conditions, with a known weight of the standard preparation; in such a procedure the variability of animal response does not affect the result.

International standards

The measures taken to deal with the problem of standardization of insulin illustrate both the basic principles of biological standardization and their formal application in practice on an international basis. The acceptance of these principles was accompanied by the realization that a number of other preparations of biological origin were in use in medicine that could not be assayed by chemical or physical means and that similar procedures could be applied to their standardization; moreover, it was clear that such preparations would increase in number, including as they did both immunological products (e.g. diphtheria and tetanus antitoxins) and a variety of other therapeutic products (e.g. vitamins and hormones). The evident international importance of such biological standardization made it a matter of interest to the Health Organization of the League of Nations, under which a Permanent Commission on Biological Standardization was set up in 1924; this continues today as a Division of the World Health Organization.

The two prime movers in obtaining recognition both of the principles of biological standardization and of its international importance for medicine and for research were Professor T. Madsen, then Director of the State Serum Institute in Copenhagen, and Dr. H. H. (later Sir Henry) Dale, who was at that time Head of the Department of Pharmacology and Biochemistry of the Council's National Institute for Medical Research. It was the practice of the League of Nations Health Organization, as it is of the World Health Organization today, to arrange for continuing work on projects of international importance to be undertaken by national agencies; it was therefore natural that international centres for work on biological standards should be set up at the State Serum Institute of Denmark and at the National Institute for Medical Research. The State Serum Institute was invited to assume responsibility for standards of immunological products and the Council for the rest. This broad division of responsibility continues, although, for various reasons, the Council have taken the initiative from time to time in work on a number of immunological standards. The scope of the work is indicated by the fact that the Division of Biological Standards at the National Institute for Medical Research has in the course of its existence undertaken the initial establishment of international standards for some sixty substances, including vitamins, hormones, antibiotics and enzymes; some of these standards have to be renewed from time to time and, in addition, national standards and reference preparations are often required for use within one particular country. The rate of demand for new standards has increased rapidly in recent years, particularly as a result of the discovery of new antibiotics and of enzymes with applications in medicine.

The establishment of a biological standard

The process of establishing an international biological standard involves several stages, the first of which is the collection of an adequate amount of suitable material containing the active principle. This material must be homogeneous but need not originate from a single source: not infrequently it is more

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convenient to obtain a number of different samples, which are bulked and thoroughly mixed. The concentration of the active principle that the material contains is not necessarily relevant to its usefulness as a standard since it will be used only for the purpose of comparison (though care must be taken to ensure that the activities being compared are similar in kind), but an essential requirement is that the standard should be stable. The conditions most likely to cause deterioration of stored biological material are exposure to light and warmth and the presence of moisture and oxygen; the material intended for use as a standard must therefore be completely dried and subsequently stored in the dark at a low temperature in sealed vessels from which the air has been displaced by an inert gas (usually nitrogen).

After the material of the standard has been prepared in this way, agreement has next to be reached on its biological activity. For this purpose, laboratories throughout the world are invited to submit samples of the preparation to biological assay and to return their results to the Department of Biological Standards at the National Institute for Medical Research or the State Serum Institute of Denmark, as the case may be. If alternative methods of bioassay exist, the collaborating laboratories are normally invited to use the method of their own choice. The collected results of bioassay are statistically evaluated and the international unit of the active substance is then defined as the amount contained in a stated weight of the standard material.

In former years it was customary to prepare biological standards in relatively small amounts. The intention was that the materials held in the International Centres in London and Copenhagen should be regarded as master standards, of which small quantities should be issued to national standards laboratories (and, on occasion, to individual recipients), where secondary standards would be prepared for continued use. To some extent this practice is still followed, but it is being found that many laboratories in developing countries and in the smaller institutions are unable to prepare satisfactory working standards. Moreover, the elaborate and time-consuming process of establishing a new standard must be repeated every time that the standard is renewed, and some materials required as standards are extremely difficult to prepare in stable form. For all these reasons therefore the tendency now is to prepare new or replacement standards in as large batches as possible; these batches are divided into small quantities and sealed in individual ampoules, which can conveniently be issued to those who need them for direct use in bioassay tests.

Use of standards in research

All that has been said so far relates to the most obvious use of biological standards, namely as yardsticks for the quantitative measurement of the activity of biological products used in the practice of medicine. The need for such a yardstick for those hormones whose activity cannot be determined by chemical and physical means, for the ever-increasing number of antibiotics and for immunological products needs no further emphasis. It should not be forgotten, however, that in addition to these immediately practical applications the development of biological standardization has been, and continues to be, of considerable service to medical and biological research.

A primary requirement for the development and use of standards is a proper understanding of the principles of bioassay (Jerne and Wood, 1949); this subject has attracted the attention of a number of workers by virtue of its interest as a

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problem in biometrics (see, for example, the pioneer work of Gaddum, 1933). Thus, as a result of the provision of standards much waste of effort in biological research has been avoided and the theory and practice of biological assay have themselves been considerably advanced. The situation also arises in which the establishment of a standard contributes substantially to research on a particular biological problem. Research workers may, however, be unfamiliar with the principles of bioassay and may therefore neither recognize the need for a standard nor realize the possible benefits of its application to their work. Moreover, the task of collecting material, preparing it in homogeneous and stable form, organizing collaborative assays and analysing the results is beyond the sphere of interest of most research laboratories. It has therefore been regarded as part of the function of the Division of Biological Standards at the National Institute for Medical Research to take the initiative in developing methods of bioassay in situations where the research is of potential interest to medicine, and to provide a standard that will enable observations to be placed on a quantitative basis. A few examples of work in which the Division of Biological Standards at the National Institute for Medical Research is engaged may serve to illustrate these points; in each of them standardization is required for the effective prosecution of research of medical importance, although the actual standard is needed for a substance that may never be directly employed in medical practice.

Rheumatoid factor. A proportion of patients with rheumatoid arthritis and certain other diseases carry in their blood a substance known as rheumatoid factor, which reacts in a test tube with slightly denatured γ-globulin. Moreover, in some patients there may be a correlation between the amount of rheumatoid factor in their blood and the severity of their disease. It has been suggested that rheumatoid factor may be an antibody directed against the patient's own damaged γ-globulin.

Methods of measuring rheumatoid factor are at present somewhat empirical. Though the rheumatoid factor appears to be able to form a complex with the patient's own γ-globulin it will combine preferentially with any γ-globulin that is slightly altered by heating or by adsorption on to a surface. Thus a measure of the active factor can be obtained by observing the reaction of dilutions of a patient's serum with γ-globulin-coated particles (human or sheep red blood cells, latex particles etc.). Although consistent results may be obtained by this method in one laboratory on the same day, a wide variation in estimates of the rheumatoid factor in a serum occurs from one laboratory to another and even within the same laboratory when assays are made on different occasions. This is presumably due to minor differences in both the techniques and the biological reagents. However, if patients' sera were to be compared with a common homogeneous and stable preparation of rheumatoid factor, in other words with a standard, it should be possible to evaluate different assay methods, and to compare assay results.

If, as the evidence suggests, the factor is indeed antibody against γ-globulin, it must be remembered that it may be not a single substance but a spectrum of antibodies directed against different parts of the patient's γ-globulin molecule. This, together with the fact that there are genetically determined chemical differences in the γ-globulin molecule itself, means that rheumatoid factor may have different specificities in different patients, and the standard clearly should

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include a wide and representative range of sera. In a recent study sera were therefore collected from 197 patients with rheumatoid arthritis; the material was then checked, pooled, freeze-dried and divided into ten thousand samples. A collaborative study has already shown that several laboratories were in agreement in their estimates of the amount of rheumatoid factor contained in a series of samples when these were assayed and compared with the standard preparation.

The second part of this collaborative study is to assay individual sera from a large number of patients. If estimates obtained in several laboratories agree, the case for using a standard will clearly have been made. It will then be possible to relate quantitatively the estimates of rheumatoid factor obtained at different times and places, and to study and compare different methods of assay. Such quantitative studies may well throw light on the pathological significance of rheumatoid factor in rheumatoid arthritis and the other diseases in which it is found and also further epidemiological investigations.

Erythropoietin. In response to the stimulus of diminished oxygen concentration in the blood, a substance known as erythropoietin appears in the serum, which, when injected into a normal animal, causes increased production of red blood cells. Evidence is now accumulating that erythropoietin controls red blood cell formation; it is also of general biological interest in that it is the first hormone that has been shown to influence the growth of a single well defined clone of cells (i.e. a group originating from a single parent cell). A standard is required for erythropoietin since it is impossible to measure the activity of preparations containing this substance except by comparative bioassay.

Although the definitive assay of erythropoietin rests on demonstration of an increase in the total mass of red cells in a normal animal, the dose required to produce this effect is large and, as the basis of an assay procedure, extravagant. It is preferable, therefore, to use animals (usually mice) which have been made more sensitive to erythropoietin through the suppression of their own endogenous red cell production; this may be achieved either by the injection of large quantities of red cells or by exposing the mice to a reduced concentration of oxygen for a few days before the test so that they are stimulated to produce an excess of their own red cells. When the animal has more red cells than it needs the rate of red cell production drops and the bone marrow will readily respond to the administration of quite small amounts of erythropoietin by increasing its production of red cells. This response may be measured either by injecting radioactive iron and estimating the amount incorporated into red cells or by counting the increase in the number of immature red blood cells (reticulocytes) in the blood.

Sources of large amounts of high-potency material are few. Plasma from severely anaemic rabbits or sheep is suitable as a standard for use in the laboratory, and active material can also be obtained from the urine of patients with severe chronic anaemia, although it only occurs in concentrations large enough to make collection worth while in the very few patients whose anaemia cannot be corrected. An advance in the assay of this hormone was, however, made when several workers contributed a number of extracts from urine collected over periods of months from some of these rare patients. The extracts were pooled and freeze-dried in ampoules to become Erythropoietin Standard B, which is now widely used by research workers.

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Plasminogen and its activators. The protein-dissolving (proteolytic) enzyme plasmin plays an important part in maintaining the fluidity of the blood by virtue of its ability to digest fibrin and thus to dissolve a freshly formed thrombus or clot. Plasmin itself is not present in plasma but is formed from its precursor substance plasminogen by an activating enzyme, kinase. Unfortunately it is not possible to assay the activity of samples of plasmin by making comparisons with a standard: plasmin has a tendency to digest itself and the standard might thus be unstable. However, a standard consisting of the precursor plasminogen is stable provided that it is not contaminated with plasmin or any activating enzyme and that it is stored under conditions that do not allow it to activate itself. The plasminogen can then be completely converted into plasmin, when required, by the addition of an activator. Collaborative studies using a standard of human plasminogen recently established for research purposes have confirmed the value of this approach to the problem.

Two of the several enzymes that activate plasminogen are undergoing clinical trials for treatment of thrombotic conditions. Streptokinase, isolated from streptococci, is the most potent activator known, but it is antigenic—that is, it stimulates the production of antibodies. The other, urokinase, is produced from human urine and is believed to be non-antigenic in man; unfortunately, because it occurs only in extremely low concentrations in urine, it is costly to prepare. An international standard for streptokinase has been set up and one for urokinase is under consideration.

These activators are usually assayed by adding them to plasminogen and measuring the rate of plasmin formation under controlled conditions. The plasmin can be assayed by measuring its proteolytic action on casein. In the blood, however, it is fibrin that is dissolved by plasmin, and proteolytic activity can be shown on a gel composed of plasmin-free plasminogen, fibrinogen (human or bovine) and agarose. Recently, a plate assay has been developed in which the gel is poured into a large flat dish, and allowed to set. Three or more dilutions of the activator being tested and the standard preparation of activator are placed in small cups on the gel in a Latin Square pattern (so that each concentration of the activator occurs once only in each of the rows and columns of the pattern). The plate is incubated overnight; as the activator diffuses into the gel, it changes the plasminogen to plasmin, which then digests the fibrinogen and produces a clear area, which contrasts with the opacity of the original gel (plate IV). The diameter of the clear area around each cup can be measured and related to the concentrations of the activators. Like the plate assay for antibiotics, this method is simple and more precise than are other methods —qualities that may make it a valuable aid in the analysis of small differences between activators.

The future

When biological standardization was first accepted as an essential part of the control of certain therapeutic substances, it was assumed that it would eventually cease to be needed. The reason for this assumption was the expectation that, whilst newly discovered active substances of biological origin clearly needed the standardization procedure so long as they were available only in the form of crude preparations, the active principles would eventually be obtained in the pure state and would then be adequately assayed by chemical and physical tests. So far, this expectation has been realized for two groups of

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substances, namely the vitamins and the steroid hormones; these are available in a pure state and are all compounds of relatively simple chemical constitution, so that it has been possible to dispense with biological assays. For these substances, reference compounds (such as those provided by the Council-supported Steroid Reference Collection) instead of biological standards may be needed to facilitate the study of their physical and chemical properties. In other cases, for example insulin and many of the antibiotics, the substances can now be obtained in pure form but, owing to their chemical complexity or for other reasons, chemical and physical tests are still not an adequate substitute for biological assay. In still other instances, namely certain enzymes and immunological products, it seems probable that comparative assay against biological standards will always be needed. Moreover, it must be remembered that there is continued insistence on more complete testing and control of drugs of all kinds intended for use in man; this will inevitably tend to increase the demand for biological standards. Apart from these practical considerations, there is undoubtedly further scope for the application of the methods of biological standardization in research. So long therefore as the present rate of development of medical and biological research continues, the responsibility that the Council have assumed for the establishment, maintenance and distribution of biological standards is likely to become a commitment of increasing magnitude.

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CHILD DEVELOPMENT IN THE TROPICS

Homo sapiens almost certainly originated in the tropics or subtropics, and probably all races are capable of flourishing in hot climates. Physiological development may be directly influenced by climate—there are, for example, indications that a high environmental temperature favours a relatively slender physique (Roberts, 1960)—but the main interest of studies on human growth and development in tropical countries is centred not so much on the direct effects of climate *per se*, but rather on the complex effects of a whole range of factors—genetic, social, nutritional and pathological. The interest is not merely academic: an improving pattern of growth is one of the best tests of a rising standard of general health. We in Britain have seen a notable improvement in the physique and health of children as a result of social advances and improved environmental conditions during this century.

The classical diseases of the tropics are gradually coming under control. Medical attention is thus coming to be focussed less sharply on diseases peculiar to the tropics, and more upon the problems which arise in any area where the bulk of the population is uneducated and superstitious and the environment is characterized by poverty, unsatisfactory diet and faulty hygiene. Such conditions make their greatest impact on children: the growth and health of children is perhaps the greatest medical problem confronting the developing countries and has become a matter of international importance.

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The pattern of medical research is changing in accordance with these trends. The Medical Research Council have established four research units in the tropics with broad rather than specialized functions: the Council's Laboratories in the Gambia (originally a Field Station of the Human Nutrition Research Unit), the Infantile Malnutrition Research Unit at Kampala, Uganda, and in Jamaica the Tropical Metabolism Research Unit and the Epidemiological Research Unit. Much of the work during the past decade has been focussed on the metabolism and on methods of treatment of the sick or malnourished child (see, for example, a review by Waterlow, Cravioto and Stephen, 1960). There is now increasing interest in the study of growth and development of children in their ordinary environment, in an attempt to obtain better understanding of the origins of disease and malnutrition. This has been accompanied by increased co-operation between research workers in the tropics and in the United Kingdom.

The scientific literature contains many reports on the growth and development of children. Yet our understanding is still far from complete, because it is difficult to study more than a few of the relevant factors at any one time. Recent trends in research emphasize the need for more complex types of inquiry, for the use of several different scientific disciplines simultaneously, and for long-term rather than short-term studies; human growth is complex and about twenty years are required before it is completed in any individual. Furthermore, the patterns of growth are continually changing in response to social evolution.

There are two different technical approaches to the study of growth. The first, and most common, is cross-sectional: numbers of children of different ages are measured and assessed on one occasion only, and from the pooled data the pattern of development with increasing age is inferred. The second method is the longitudinal or cohort study, a group of children being studied at intervals over a period of time. This method can yield much detail, but is tedious and costly; furthermore, environmental changes may occur during the course of a longitudinal study and complicate the interpretation of the results. A useful compromise is to follow children in different age groups for a relatively short period of time, so that a semi-longitudinal picture of growth is obtained.

Prenatal growth and development

Almost all our information on prenatal growth is based upon measurements made as soon as possible after birth. Hytten and Leitch (1964) have collated representative data on birth weights from many parts of the world. Despite the crudity of much of the original material, the following picture seems to be quite well established. Average birth weights in all ' Caucasoid ' (' European ') ethnic groups, regardless of the country of their origin, are mostly about 3300 grams (about 7¼ lb). At the other extreme, average birth weights for Indians and Ceylonese and also pigmies are usually about 2700 grams (about 6 lb) or less. For all other ethnic groups the averages are slightly less than those for ' Caucasoids '. Within all groups, there is clear evidence that babies are bigger in the more prosperous sections of the community and smaller in the less prosperous. Indeed, it seems that differences in standards of living may explain some differences that at first sight appear to be ethnic.

It is tempting to interpret these socio-economic trends as reflecting differences in the diets taken by mothers during pregnancy, but this view is almost certainly too simple. Physiological studies in the Obstetric Medicine Research Unit and at

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the Nutrition Research Unit of the Indian Council of Medical Research, together with some reports of changes in birth weights during famine, indicate that foetal growth is not readily influenced by the type of diet taken during pregnancy; within a wide range of nutritional circumstances the foetus will grow almost normally, if necessary at the expense of the maternal tissues. The long-term history of the mother and her physical size may be of greater significance than is her diet during pregnancy. Where children grow poorly as a result of unsatisfactory nutrition or of disease the adults are usually small, and similarly where the children's growth is good the adults are commonly tall. As yet we do not sufficiently understand the relative importance of nature and nurture in determining adult size. What we do know is that, in general, the size and vitality of the baby at birth are related to maternal size. In Britain short women have smaller babies, with higher perinatal death rates, than do tall women, and short women occur more commonly in the poorer sections of the community (Illsley and Kincaid, 1963). Studies of the influence of maternal size on birth weight and perinatal mortality were recently extended to include Chinese mothers, by collaboration between the Council's Obstetric Medicine Research Unit and the Department of Obstetrics at the University of Hong Kong (Thomson, Chun and Baird, 1963). The Chinese mothers were, on average, about 2 inches shorter than mothers in Aberdeen, yet—in marked contrast with findings of previous investigations—the two groups had babies of similar average size, which indicates that the stature of the Chinese women was determined by genetic rather than environmental influences; moreover, the mortality rates were astonishingly low in Hong Kong, even though the mothers came from a relatively poor section of the community.

Growth during early infancy

Reports from all parts of the tropical world agree on one remarkable fact: that even where poverty, undernutrition, malnutrition and disease are widespread most babies grow well during the first few months of life. The rates of growth are similar to—and may even exceed—the rates that are regarded as optimal in Europe and the United States.

The very satisfactory growth of young babies in impoverished tropical areas is associated with the almost universal practice of breast feeding. Possibly as a result of generations of natural selection, most mothers seem to be very efficient producers of breast milk; and it also appears that the nutritive value of the milk is little impaired by malnutrition, hard physical work, or most forms of disease. Nor is breast feeding impeded by false modesty or exacting feeding schedules; the child is continuously with the mother, and is fed whenever it shows signs of hunger by day or night. In the Gambia, babies may be fed not only by their own mothers but by other lactating women, feeding being instituted as soon as possible after birth. In cases where the mother does not produce sufficient breast milk, or dies, other women may take over the feeding of the baby.

It cannot be doubted that the mainstay of the growth and health of young infants in underdeveloped tropical communities is this satisfactory breast feeding. The environmental hygiene and the knowledge of nutrition and of the causation of disease in such countries resembles conditions in Britain more than half a century ago, when artificial feeding was rightly condemned as difficult and dangerous. In the West, in spite of much propaganda in its favour, breast

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feeding has steadily lost popularity, but advances in hygiene, education and technology have made artificial feeding safe and satisfactory under most circumstances (Aitken and Hytten, 1960). Sanitary and educational revolutions must accompany any nutritional revolution. It could be disastrous if artificial feeding were to spread too rapidly to unsophisticated and unhygienic tropical communities.

There are other ways in which the young baby in the tropics is safeguarded during the first few months of its life. A high level of passive immunity to many of the common diseases is transmitted from the mother during foetal life. Malaria, measles, respiratory infections and septic lesions (except those of the umbilicus) are rarely found in Gambian babies, for example, during the first few months of life, though they are common—and often lethal—later on. Immunity to malaria (assessed by the fluorescent antibody technique) falls in Gambian infants from a high level at birth to low levels by the fourth month of life (McGregor *et al.*, 1965).

The extremely satisfactory pattern of physical growth in very young African babies may be accompanied by superior psychomotor development: workers at Kampala (Geber and Dean, 1957; Geber, 1958, 1960) have reported that the psychomotor development of African infants at birth and during most of the first year tends to be well ahead of that of European infants.

Growth after early infancy

Reports from almost all underdeveloped tropical countries agree that from about 6 months of age the physical growth of infants becomes severely retarded by comparison with Western standards. The Kampala workers noted that East African children tended to lose their early precocity and that a certain stagnation in their development appeared. By the time they are 2 years old most children in tropical countries are much smaller and lighter than their European counterparts. The setback to growth is accompanied by a high incidence of disease and by high mortality rates. In most countries kwashiorkor and marasmus—conditions attributed to protein–calorie malnutrition—usually reach their greatest prevalence during the second year of life.

The reasons for this transformation are complex. In the first place, the infant begins to outgrow his basic diet of breast milk at 4–6 months of age. Weaning is often delayed until a later stage, but the supplementary food provided may be insufficient and of poor nutritive value, as well as bulky and unattractive, especially to an ailing child. The food and the water supply are likely to be highly contaminated so that gastrointestinal infection and parasitism are common. Secondly, the child's passive immunity to many infections has largely disappeared by about 6 months of age, and the load of infection may be so heavy as to swamp the remaining defences, though if the child survives he will of course in time develop active immunity as a result of infection, at least to some diseases. Finally, when the baby becomes too heavy to be with the mother continuously, he may be under rather casual supervision, and his social environment may change completely. Geber and Dean (1957) reported from Kampala that up to his second year the East African child normally lived in a warm friendly world, but then found himself very much neglected. They observed that although the custom in the first year was that the child should be satisfied completely it was exactly the opposite in the second year, when very little attention was given him.

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In a study carried out by Council workers in the Gambia at Keneba, a fairly remote village where Western influence remains slight, births and deaths have been recorded and children have been weighed annually since 1950 (McGregor, Billewicz and Thomson, 1961). In brief, the common pattern of growth in the tropics was found: weight gains were very satisfactory up to about 6 months of age but they were followed by a setback from 6 months to about 2 years. Thereafter the annual increments of height and weight were similar to those of children in Britain, but the leeway was not made up, so that the Gambian children remained shorter and lighter than British children of the same age group. Nearly half the children died before reaching the age of 7 years. The peak mortality was in children aged about 1 year, and the death rate remained high until 4 years of age. Deaths were much more common during the rainy season than at other times of year, and the pattern of mortality within particular age groups seemed to depend to some extent upon season of birth. Epidemics could have serious effects: in 1961, measles killed about 18 per cent of children under 5 years of age.

As a result of these findings, it was decided to conduct a more intensive investigation in Keneba, involving co-operation between the Council's Laboratories in the Gambia and their Obstetric Medicine Research Unit in Aberdeen. All children in the village aged under 5 years were weighed at short intervals and as much information as possible was collected about health, feeding and patterns of child care. This study was complemented by somewhat similar observations—with more emphasis on clinical aspects—on infants attending a clinic at Sukuta, near Bathurst, the capital of the Gambia (Marsden, 1964).

From the results of these intensive studies, some very interesting patterns have emerged. In the first place, the smooth average growth curves previously derived from annual measurements are shown to conceal remarkable seasonal fluctuations. Figure 1 shows the average weight curves of four groups of

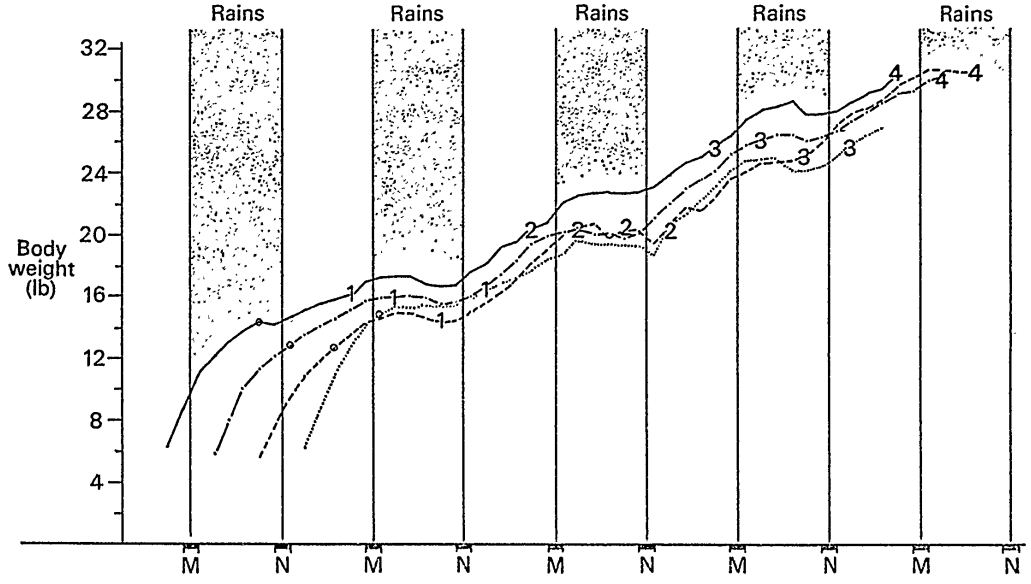

Figure 1

Average weights of rural Gambian children from birth to 3 or 4 years of age. The four curves indicate children born at different seasons of the year, ages being shown in years on the curves.

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children born in Keneba at different seasons of the year. The infants in all the groups grew very satisfactorily during the first few months of life, irrespective of season. Thereafter growth, assessed in terms of weight increase, appeared to depend almost entirely on the season. During the rains (from May to November approximately) growth almost ceased. During the dry season gains in weight were considerably in excess of those for British children of the same age. The periods of gain and setback averaged out by the time the children were about 2 years of age, so that those of similar age then weighed roughly the same, regardless of season of birth. Patterns of growth in height (measured every 3 months) resembled those found for weight.

The reasons for these remarkable seasonal fluctuations of growth in Keneba have not yet been fully analysed, but infectious disease, especially during the rainy season, appears to be a dominant factor. Figure 2 gives the pattern of

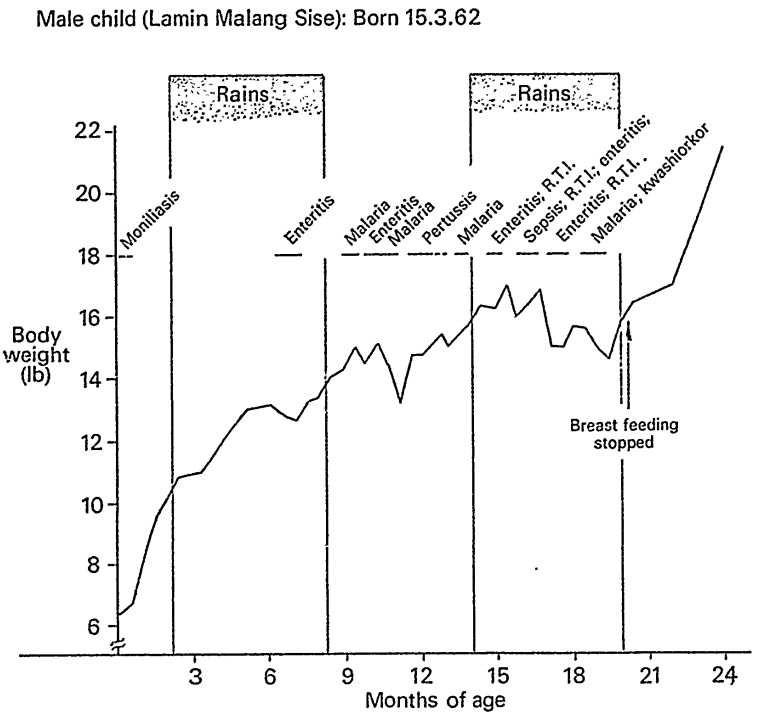

Figure 2

Weight curve of a West African child who developed kwashiorkor at 19 months of age, indicating the main diseases he suffered (R.T.I. = respiratory tract infection).

growth in one child who developed kwashiorkor at 19 months of age. The close association between disease and growth seems clear, and it is probable that the appearance of kwashiorkor was related at least as much to the long succession of illnesses shown in the figure as to a primary dietetic defect. Recovery from kwashiorkor, in this particular child, was probably assisted by giving the mother a supply of dried milk powder, and by prescribing chloroquine for malaria. It should be noted, however, that breast feeding ceased about the same time, and that during the period of extremely rapid growth, from 21 to 24 months of age, no food supplements or special treatments were given.

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In the Sukuta study referred to above, Marsden noted the strikingly large burden of disease. His report indicated the complex environmental background that has to be understood before either effective treatment or effective prevention of disease will become possible. Clinical illness is frequently the handmaiden of faltering growth, and these two phenomena develop against a background of poverty, superstition, ignorance, agricultural and domestic drudgery and barely adequate nutrition.

The patterns of growth and disease found in the Gambia are scarcely peculiar to this locality; there is no doubt that great variations in growth occur in different parts of the world, and that studies of such variations would improve our insight into their causation and might thus help to suggest the means of achieving satisfactory growth patterns everywhere. A study of growth similar to the one carried out in the Gambia has recently been started by the Council's Epidemiological Research Unit in Jamaica, with financial assistance from the Association for the Aid of Crippled Children (New York). The population under investigation is of predominantly West African origin, but the environment is entirely different from that of the Gambia and mortality rates in young Jamaican children are much lower. Preliminary results have already shown that faltering growth is very common at all seasons of the year.

Growth at school age

The Epidemiological Research Unit in Jamaica has made a number of cross-sectional surveys of schoolchildren (Ashcroft and Lovell, 1965a, b). The heights and weights of children from the poorer socio-economic groups in this area are considerably below those of British children today; these children are, in fact, similar in height to British children two or three generations ago. It is, however, encouraging to note that the heights and weights of Jamaican children seem to have increased during the past 15 years, despite overcrowding and the prevalence of poverty. Another study dealt with children from prosperous homes but of differing ethnic origins. The ' Africans ' were just as tall as the ' Europeans '. Similar findings have been reported from Nigeria by Collis, Dema and Omololu (1962). This helps to confirm that the retardation of growth in young African children is of environmental rather than genetic origin. On the other hand ' Chinese ' children from prosperous families in Jamaica were considerably smaller than the ' African ' and ' European ' groups.

Prevention and treatment of disease

From a theoretical point of view, there is little doubt that the best way of ascertaining the influence of various aspects of environment upon growth and health would be to alter them one by one, or in combination. For example, the nutritional factor might be eliminated by the provision of a satisfactory diet, or the disease factor might be studied by the application of appropriate measures for prevention and treatment.

Unfortunately, research along these lines is exceedingly difficult in practice, and raises ethical as well as scientific and administrative problems. The Council's Infantile Malnutrition Research Unit in Uganda has put considerable effort into the development of food supplements which, if given to apparently malnourished children, should remedy the chief dietetic deficiencies. Such supplements have been very useful in the treatment of kwashiorkor and similar conditions, but much less success has attended attempts at prevention. The late Professor

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R. F. A. Dean, the director of this unit until his death in 1964, concluded that very little improvement was likely to be achieved until the parents had been taught the elements of nutrition and had come to realize that young children need special care, which includes a special diet; the chief barrier, he believed, is our imperfect understanding of the ideas and customs of the local people. The study of nutrition and growth must indeed make use of some of the techniques of the anthropologist.

Studies of the effects of mass treatment of specific diseases have been made in the Gambia. On the whole, the results were disappointing in terms of improvement in growth rates, although suppression of malaria seemed to lead to a slight improvement at early ages (McGregor *et al.*, 1956). This serves to illustrate both the practical and the ethical problems. Children in the tropics can avoid contracting malaria if they swallow a small tablet of chloroquine once a week. These tablets cannot, however, simply be handed over to an uneducated community, for they would not be taken regularly and conscientiously. In the Gambian trial, each child had to be visited weekly, usually at his home or, occasionally, out in the rice swamps, a procedure which was not only laborious but greatly restricted the number of children that could be studied. The children so treated were not infected with malaria, but at the end of the trial presumably they did not possess the high level of acquired immunity possessed by the surviving untreated children. We cannot be certain whether prevention of disease during the very dangerous early years of life may not simply postpone the danger period. Clearly in any programme of ' preventive ' research the ultimate consequences must be carefully considered and weighed against the immediate advantages.

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DIURNAL RHYTHMS IN HUMAN PHYSIOLOGICAL PROCESSES

From the times of his earliest history, man's behaviour patterns have been related to recurring cycles of events in his natural environment. The breeding periods and migratory movements of animals and the cycles of growth and maturation of plants were of vital importance to him if he was to obtain adequate food and clothing; in most parts of the world seasonal climatic changes affected him too, leading him to seek the means of providing himself with shelter and warmth and with a supply of water that would neither dry up nor freeze in extremes of heat or cold. Man has thus not only survived, but has so exercised his ingenuity and developed his skills that in present-day civilized communities he is to a large extent insulated from his natural environment and is relatively independent of annual rhythmic changes. There remains, however, one type of environmental fluctuation of which he is still constantly aware, namely the daily cycle. Primitive man was forced to confine his activities to the light time and to remain inactive during darkness, and modern man still prefers to work and play during the hours of daylight and to sleep at night. This regular alternation of sleep and wakefulness is reflected by fluctuations in the levels of certain physiological functions; the study of the initiation and maintenance of these rhythmic variations is not only of basic scientific interest but has important practical applications. Several of the investigations referred to in this article have been carried out by workers from the Human Physiology Division of the National Institute for Medical Research.

Light and darkness

Nocturnal sleep is a universally recognized rhythmic feature of man's life. Under normal conditions—that is, in an environment of light days for work and dark nights for sleep—the daily variations in heart rate, blood pressure, respiration rate, motor activity, body temperature and urinary excretion are synchronized so that they all show high levels during the daylight hours and are at their lowest in the hours of darkness, at some time between midnight and sunrise (Kleitman, 1939). The most plausible explanation for this synchronization is that it is simply a manifestation of the activity pattern. This would imply that the basic ' biological clock ' controlling the rhythms is inherent in the mechanism that induces sleep, and that if the sleep pattern were altered one would expect to find similar alterations in all the other physiological patterns. Though sleep is an extremely complex physiological state, the sleep pattern can be altered in man with very little difficulty. Provided that the average amount of sleep over several days is adequate, changes in the time at which sleep is taken do not appear to affect man's comfort or well-being (Lewis, 1961). If a change is made in the time at which sleep is normally taken, although some physiological trends immediately fall into phase with the new pattern others remain for an appreciable

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time synchronized to the original activity pattern. This has been observed both within the framework of the normal 24-hour day (Mills, 1951) and when, under suitable conditions, such as Arctic day or night, the actual length of ' day ' has been altered (by the use of specially adjusted wrist watches, for instance) to a period longer or shorter than 24 hours (Lewis and Lobban, 1957a,b). Thus it would appear that there are in man intrinsic physiological daily rhythms, which are maintained independently of his activity pattern.

A great deal of evidence is available on the existence of intrinsic diurnal physiological patterns in the lower animals (Kleitman, 1949; Harker, 1958; Aschoff, 1963). Experimental animals have been isolated in a constant environment (usually in continuous darkness) for considerable periods of time, and it has been found that their physiological rhythms have a periodicity of approximately, though not exactly, 24 hours (DeCoursey, 1960). These intrinsic rhythms, which are termed ' circadian ' rhythms (from *circa diem*), can be made to take on a periodicity of precisely 24 hours if even quite short periods of light are introduced into the otherwise dark environment every 24 hours; the light acts as a *Zeitgeber* or time clue, a synchronizing agent pulling the intrinsic circadian rhythms into phase with the 24-hour period (Aschoff, 1960). Although it is difficult to make observations of this kind on man, a number of human subjects have been studied under conditions of isolation and complete insulation from their natural environment, with very similar results (Aschoff and Wever, 1962): the intrinsic free-running physiological rhythms in man appear to be circadian rather than to have a periodicity of precisely 24 hours. The inference here is that the normal 24-hour periodicity is produced by the action of a *Zeitgeber* in the natural environment.

Many of the physiological rhythms that have been observed in man do not lend themselves satisfactorily to experimental study, since comparatively minor changes of activity or emotional factors can produce variations that may be much greater than are those normally observed throughout the course of the daily pattern. There are, however, two rhythms—those of the daily fluctuations in body temperature and of the rates of excretion of certain urinary constituents (Stanbury and Thomson, 1951; Halberg, 1960)—that are relatively stable, and it is with observations on these that recent work, carried out both in this country and abroad, is mainly concerned. It is comparatively easy to follow the variations in body temperature and urinary excretion in human subjects both in the laboratory and in natural conditions, and observations have been made in a variety of environmental and clinical conditions. The main aims of such investigations are: (i) to determine the typical forms of the daily rhythms under normal environmental conditions; (ii) to evaluate the role of environmental factors in the maintenance and synchronization of the rhythms by studying the effects of environmental changes on the established pattern, and (iii) to attempt to identify the site and nature of the intrinsic controlling ' biological clock '.

In normal adult human subjects working during the hours of daylight and sleeping at night in an environment of light days and dark nights, levels of body temperature measured during the period of activity are significantly higher than those recorded during sleep. Similarly, the rates of urinary excretion of water, sodium, potassium and chloride are higher during the daytime than they are at night, characteristically being highest between 12.00 and 18.00 h and lowest between 02.00 and 08.00 h. These daily rhythms are not present in the

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newborn infant, but are developed from the more complex rhythms occurring during early life (Hellbrügge, 1960). In people who are born and spend the whole of their lives in the high latitudes of the Arctic, however, where for a great part of the year the normal daily alternation of light and darkness is absent from the environment, daily rhythms of urinary excretion are less marked or absent. Similarly, people from temperate zones who live for long periods of time in Arctic conditions tend to show a less pronounced daily rhythm of urinary excretion; but in those who are exposed for only 8–10 weeks to the continuous daylight of the Arctic summer the physiological rhythms are maintained in their original form. Recordings of levels of urinary excretion and of body temperatures in an indigenous Arctic community taken in midwinter, in the complete absence of true daylight, show an even less regular pattern than do readings taken on the same subjects at midsummer, when the sun is above the horizon throughout the 24 hours of the day—in spite of the fact that the activity pattern for all individuals was far more irregular in midsummer than in midwinter (Lobban, 1960). These findings indicate that it is not man's activity pattern but rather the regular alternation of light and darkness that plays the major part in the initiation and maintenance of daily physiological rhythms, just as it does in the lower animals. This hypothesis is further strengthened by the observation that in people who become totally blind after experiencing a period of normal sight, the urinary rhythms are found to be diminished, disorganized and temporally desynchronized, while the rhythms of subjects who still retain some ability to distinguish between darkness and light are identical with those of normal-sighted subjects (Lobban and Tredre, 1964).

Time patterns

As man is aware of light and darkness, so civilized man is increasingly aware of the passage of time. It would be difficult to study the influence of this factor by altering the periodicity of the pattern of his activity in a normal light–dark environment because an exceedingly complex situation would be created; but since we know that normal daily physiological rhythms can be maintained for two or three months in the continuous daylight of the Arctic summer, it is possible to carry out experiments on alterations in the activity pattern in this comparatively constant environment (Lewis and Lobban, 1957a, b). Subjects living in isolated communities in continuous daylight for periods of up to eight weeks on a routine of 21-, 22- and 27-hour ' days ' show a very rapid adaptation of their body temperature rhythm to the new time routine, but their urinary rhythms adapt only slowly, or fail altogether to become synchronized with the altered time-scale. When the activity pattern is reversed in relation to the solar time pattern and subjects are awake and active during true night-time and are sleeping during the day, urine production is very low during the period of activity and very high during sleep; thus a marked dissociation arises between the rhythms of body temperature and those of urinary excretion. After two or three weeks of life on an abnormal time schedule, further dissociation is seen in the rhythms of urinary excretion; the excretion of water, sodium and chloride tends to follow the pattern of activity while the excretion of potassium remains synchronized with solar time. This might appear to suggest that the normal daily rhythms of changes in body temperature, levels of water, sodium and chloride excretion and of potassium excretion may be controlled independently, and that each rhythm has its own separate ' biological clock ', which is normally synchronized by clues given by the environment. This is considered unlikely to be true, but it is

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certain that the observed dissociations indicate clear differences in the sensitivity of the rhythms to environmental influences. The rhythm of potassium excretion stands alone in that its controlling mechanism appears to be far more sensitive to the very weak environmental time-clues that exist in the Arctic summer day than are those of the other daily rhythms; thus it retains its original form even when the pattern of the subject's activity diverges from solar time. In any case, the balance between the effects of environmental time and ' experimental time ' is a very delicate one, even when rhythms are apparently well adapted to the abnormal time routines. This becomes clear at the end of a period of life on an abnormal time schedule, when the subjects return to a normal, 24-hour routine of activity. In every case, irrespective of the degree of adaptation, all the observed physiological rhythms immediately become resynchronized to solar time. Thus it seems that man adapts only very slowly to an abnormal time routine; although physiological rhythms gradually change to fit a new pattern they will nevertheless revert almost immediately to normal when a normal pattern of activity is resumed. Furthermore, it would appear that such changes in rhythms can take place only to a limited extent: the body temperature rhythm adapts readily to a 21- or 27-hour day, but adaptation to a complete reversal of the activity pattern within the framework of the normal 24-hour day, of the kind that occurs in night-work, is a much slower process, and may not occur at all (Van Loon, 1963).

Practical applications

The occurrence of natural physiological rhythms associated with the normal 24-hour day clearly has a bearing on the problem of abnormal work schedules. Shift systems are relatively common in many industries, and an increasing number of members of civilized communities are being asked to work efficiently at unusual times. It would seem logical to suppose that man ought to be at his most efficient when his daily activity pattern and physiological rhythms are in good temporal synchronization. Daily patterns in levels of efficiency and performance that correspond very closely to the physiological rhythms have indeed been demonstrated by Colquhoun (1960) at the Council's Applied Psychology Research Unit. The individual worker in a modern community, in a social milieu geared to working during the daylight hours and sleeping at night, is at a disadvantage when he tries to adapt himself to night work. Both the activities of the community as a whole and the daily environmental fluctuations militate against adaptation; and in many shift systems, where the hours of work change from week to week, there appears to be insufficient time for physiological adaptation. In an Arctic mining community in winter, where the social organization and the minimal fluctuations in the environment help to create a situation favourable to variations in working hours, it does seem that adaptation is more satisfactory than elsewhere (Lobban, 1963). The night-shift workers in the mines, whose working hours do not vary from week to week for the whole winter, show excellent adaptation of their rhythms of potassium excretion to their working day: but even so some dissociation of this rhythm from the other physiological patterns occurs with the return of the sun. When the light–dark alternation is re-established, the rhythms of water and sodium excretion, which have become much less pronounced in the winter darkness, appear again in phase with solar day, not with the working day. Thus the daily rhythms of water and sodium excretion and potassium excretion are desynchronized, with a phase difference of 16 hours between them. This is

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an intriguing finding, in that the potassium rhythm, normally so strongly bound to solar time, has completely changed; as far as this rhythm is concerned the men have become nocturnal animals. It is interesting, too, that the night-shift workers, under these specialized conditions, appear to be among the happiest and best adjusted groups in the community. There is some suggestion that the form of the potassium rhythm is of special significance for the evaluation of the degree of adaptation attained by human subjects to abnormal time routines, and for the assessment of the consistency and regularity of the 24-hour pattern under normal circumstances. We do not know if this is so, but it may be relevant to the question of adaptability that the only human subjects amongst whom a consistently high proportion of examples of distorted potassium rhythm is found under normal conditions (a 24-hour day, and regular alternation of light and darkness) are certain depressive psychiatric patients (Lobban *et al.*, 1963).

Adaptation to an unusual time routine is, as we have seen, a slow process even under favourable conditions, and it would seem likely that abrupt changes in time-scale could have an adverse effect upon the individual's efficiency and well-being. With the increasing use of jet flight as a mode of transport and the consequent compression of lines of longitude, such sudden changes in environmental time constitute a real hazard for the traveller. Subjective accounts of the fatigue and temporal disorientation which many people experience, for example immediately after transatlantic flights, are legion. Studies of the physiological daily rhythms and performance in such travellers show conclusively that some three to five days are required for a tolerable degree of adaptation to the new time-scale to be attained, and that the transition period is characterized by a loss of efficiency (Hauty and Adams, 1965).

Controlling mechanisms

It is hoped that it may be possible in the future either to select particularly adaptive individuals for work under specialized time chedules or so to design shift systems that the maximum well-being and efficiency of the workers is ensured. Carefully planned studies—for example observations on subjects who have to be alert and efficient at unusual times—may well lead to a better understanding of the basic mechanisms involved.

The site and nature of the intrinsic 'biological clock' is not yet known in man; but the evidence for the existence of both labile (readily adaptable) and stable (refractory to change) components in human physiological diurnal rhythms suggests that at least two basic mechanisms are involved in the initiation of these rhythms and their synchronization within the 24-hour period of the normal day. The requirements of such a system could be fulfilled by the interplay of rhythmically functioning elements in the central nervous system and in the adrenal cortex, and recent work suggests very strongly that it is the inherent hormonal diurnal rhythm that underlies the circadian fluctuations in man's physiological processes (Halberg *et al.*, 1961). Adrenal cortical secretion, as indicated by the levels of 17-hydroxycorticosteroid in the blood, shows a daily rhythm in which maximum levels are attained some two hours before the time of maximum excretion of urinary electrolytes (Migeon *et al.*, 1956). In adjustment to sudden changes in environmental time (Flink and Doe, 1959) and to maintained alterations in the daily activity pattern (Sharp, Slorach and Vipond, 1961), adrenal cortical secretion may be taken as an index of adaptation. Thus it may well be that man's 'circadian clock' is situated in the adrenal

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cortex, and that the precise synchronization of his biological rhythms to a 24-hour periodicity is brought about by his perception of—and response to—environmental factors. Such a system could be very flexible, and would permit of individual variations such as have been observed in experimental studies.

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It is tempting to believe that uncomfortable conditions of work decrease human efficiency. One might argue therefore that it must prove economic to maintain a comfortable temperature in places of work, to keep noise levels tolerable, and so on. Unfortunately, experiments show that bad conditions do not necessarily make work worse, and people who are especially annoyed by noise, for example, are not always those who work least well in it. Some practical men also may point to experience of working on ships in extremely hot climates, of operating looms amidst high-intensity noise, or of performing clerical work after sleepless nights, in order to argue that comfort is really unimportant for working efficiency. The fairest conclusion to draw from everyday experience of the effects of discomfort upon work is therefore perhaps an agnostic one; and it is necessary to have recourse to objective experiment before deciding whether a particular stress is merely an unimportant annoyance or a true cause of inefficient work.

Since the end of the second world war there have been a large number of laboratory experiments on working efficiency in heat, in noise, following loss of sleep, and to a lesser extent in unorthodox environments such as marked vibration or high-pressure air. All these conditions have been shown to produce some deterioration in work, and one object of the research has been to find the critical limits beyond which deterioration can sometimes be found (see review by Broadbent, 1964). Experiments on the effects of heat, for example, demonstrate that an impairment of work begins to occur at about 26–29°C on the effective temperature scale (which takes into account humidity and rate of air movement as well as temperature readings) in British, American and African subjects alike and in a variety of tasks. In conditions of loud noise, a drop in efficiency has been found only when the level of the noise is more than about 95 decibels above the usual arbitrary zero—that is, when the noise becomes so loud as to make communication impossible even by shouting. In the case of sleeplessness, the least deprivation that has yet been shown to produce an effect is a night spent completely without sleep (some effect of this deprivation being found even after one night's sleep has intervened).

The level at which some of these stresses appear to affect working efficiency is surprisingly high, since there is as yet no reliable evidence that the loss of half a normal night's sleep or the noise of a busy typing pool depresses general efficiency, however uncomfortable they may be. With other stresses the limits seem quite low: it is now possible to show a deterioration of performance when the normal atmospheric pressure is doubled, corresponding to the pressure conditions experienced by a diver only 10 metres or so below the surface of the water (Poulton, Catton and Carpenter, 1964). In the case of heat the normal limit for efficiency is at about the point where the climate becomes uncomfortable, though there is also evidence that extreme conditions well beyond that point may be compatible with efficiency, perhaps through some compensatory mechanism (Bell, Provins and Hiorns, 1964). However, it is possible to counteract the effects of an unpleasant environment by altering the nature of the work in quite small ways. This has been shown for noise, for heat and for sleeplessness. Clearly therefore it is not sufficient merely to know whether or not the environmental conditions are outside the limits of comfort

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if we wish to predict whether work is going to be inefficient. Consequently research is concentrating increasingly on an analysis of the mechanisms by which different forms of stress produce their effects.

Differences between stresses

A group of investigators at the Walter Reed Institute in Washington have urged strongly that the effect of sleeplessness is to increase the number of errors of omission—that is, the occasions on which a man fails to perform some action that he ought to have performed (Williams, Lubin and Goodnow, 1959). This tends to produce moments of inaction during a job performed continuously at the subject's own speed, and occasional failures to react in a job that has to be executed at a speed determined by the experimenter. Such errors of omission could plausibly be regarded as brief instants of sleep, whose effect upon work might be serious if the task demanded continuous attention, but would be unimportant if the nature of the work were such as to make irrelevant a very temporary absence of mind. Between these instants of failure there may be compensatory increases in the rate of work, so that the overall average speed is unaffected. This explains the fact that only certain kinds of job will reveal the change in the man's efficiency. A number of experiments carried out at the Council's Applied Psychology Research Unit (reviewed by Broadbent, 1964) have also tended to show the effects of sleeplessness to be brief periods of inaction in the course of continuous work. A very noisy environment on the other hand has often been found to result in errors of commission rather than omission: the worker is overactive rather than underactive, but he does the wrong things. The effects of noise can to some extent be summarized as excessive activity, and those of sleeplessness as inactivity; but both types of stress produce the greatest effect towards the end of a period of work rather than at the beginning, and they cannot be regarded as simple opposites.

Despite this reservation, there are a number of other respects in which the effects of noise are opposed to those of sleeplessness. If we compare two jobs that demand action at different intervals, the task which keeps the man busier is less affected by sleeplessness. If two such tasks are compared in a noisy environment, however, there is some evidence that the task requiring more frequent attention is the more seriously affected. The provision of extra incentives to increase enthusiasm for work, such as frequent information about performance, reduces the effect of sleeplessness but makes the effect of noise more serious. Perhaps most strikingly, the effects of noise and sleeplessness in combination tend to some extent to cancel each other out, so that there is less difference between the sleepless and the normal man when both are working in conditions of loud noise than in ordinary conditions. It seems reasonable to conclude therefore that sleeplessness and noise both tend to militate against some optimum ' average ' state, but do so in opposite directions.

The ill effects of heat, however, do not seem to bear any simple relationship to those of noise or sleeplessness. The type of breakdown of efficiency that appears in tests similar to those used with noise and sleeplessness takes the form of errors of commission rather than omission, but the effect seems to appear as soon as the task is begun, instead of occurring only towards the end of a work period. Furthermore, incentives seem to have no influence on the effects of heat; and so far attempts to apply heat and noise simultaneously or heat and sleeplessness simultaneously have not demonstrated any cancellation

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or augmentation of the effect of one by the presence of the other. It would, however, be rash to conclude that the effects of heat are entirely different in kind from those of the other two stresses, since it is possible that one kind of effect is produced at a moderately high temperature and another kind in even greater heat, while the picture may be greatly complicated by the success or failure of the body's mechanism for regulating its own temperature.

Mechanisms underlying the effects of stresses

Since the presence of loud noise modifies the effects of sleeplessness, the two stresses must be supposed to have some mechanism in common. Sleep is known to have some connection with the general mechanisms of arousal operating through the network of nerve fibres known as the reticular formation at the base of the brain, work on which has been reviewed by Oswald (1962). In addition to the ' classical ' pathways from sense organs to cortical projection areas, which convey specific information about events in the outer world, there are nerve pathways carrying non-specific information from the various sense organs, which pass through the reticular formation and disperse widely throughout the brain. The normal waking state seems to depend upon the integrity of these non-specific pathways, and some authors thus find it useful to assume a general state of ' arousal ' or responsiveness of the nervous system, which is maintained by a continual flow of stimulation and which drops to a low level during sleep. Such a general level of arousal might be conceived as being related to working efficiency, too low or too high a level producing defective work through errors of omission on the one hand or commission on the other. One might then suppose that sleeplessness changes the level of arousal in one direction, while loud noise changes it in the other, which would explain the partial cancellation of the effects of the two stresses when they coexist.

It is not immediately obvious, however, that sleeplessness reduces rather than increases the level of arousal: it can be argued that deprivation of sleep increases the general level of activity. Such a view has been strongly urged by Canadian investigators (Malmo and Surwillo, 1960) as a result of their studies on sleepless subjects carrying out stimulating tasks. There are certain physiological variables that are assumed to be related to the general level of arousal, including EEG patterns, conductance of the skin, muscle tension, heart rate, respiration rate, body temperature, and so on. In the Canadian studies such indices of arousal showed a rise as periods of sleep deprivation continued. Similar results have been obtained in animal experiments. It seems clear, however, that this rise in the physiological indices of arousal will occur only if the sleepless person is highly stimulated in some way to keep him awake. Other investigators, such as Corcoran (1964) at the Council's Applied Psychology Research Unit, have found that the level of arousal drops when men do some relatively unstimulating task while deprived of sleep. Since such unstimulating tasks are those that reveal the greatest ill effects after sleeplessness, it would seem that the effects must in fact be due to too low rather than too high a level of arousal. The fact that noise, which seems to raise rather than lower the physiological indices of arousal, reduces the effects of sleeplessness is also consistent with this view. It must be emphasized, however, that these arguments apply only to experimentally induced sleeplessness. In ordinary life sleeplessness may result from worry or anticipation, and it cannot be assumed that insomnia of this kind will resemble sleeplessness that is free from emotion.

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At least two explanations may be put forward for the apparent high level of arousal of sleepless laboratory subjects in stimulating conditions. One view is that sleeplessness changes the relationship between arousal and external stimulation, the level of arousal being far more dependent on external stimulation than it is in the normal person. An alternative view is that the rise in the physiological indices really reflects a compensatory activity or ' effort ' (counteracting the naturally low level of arousal) that is called into play under conditions of sleeplessness. Such effort, it may be suggested, maintains unchanged the normal level of psychological arousal, which on this view cannot be directly measured by the present physiological techniques. Wilkinson (1962), at the Council's Applied Psychology Research Unit, found that performance in an arithmetical task was impaired least in those sleep-deprived subjects whose muscle tension was most raised.

Neither of these views can be put forward with complete conviction at present, but it is interesting to note the relationship between the second one and the hypothesis of Mirsky and Rosvold of the United States National Institute of Mental Health (1960) concerning the effects of drugs on behaviour. These authors distinguished two classes of drugs. One class, which includes barbiturates, impairs performance both when the rate of work is externally imposed—for instance when a series of signals demanding response is transmitted to a subject—and also when a task is carried out at the individual's own speed; these drugs they regard as depressing the mechanisms both of the lower centres of the brain, including the non-specific sensory pathways of the reticular formation, and of the cortex. The second group, which includes tranquillizers, produces less impairment of performance in self-regulated than in externally controlled tasks, and these drugs are held by Mirsky and Rosvold to depress the subcortical mechanisms while leaving the cortex relatively unaffected. Sleeplessness has effects on working efficiency similar to the effects produced by drugs of this group; it could thus be assumed to leave the higher mechanisms of the brain unimpaired while depriving them of the impetus that they normally receive from the lower centres that regulate the level of arousal.

Despite the reasons already noted for regarding stress due to heat as rather different in kind from the effects of sleeplessness and noise, a change in the level of arousal may be associated with it. In a study by Wilkinson, Fox, Goldsmith, Hampton and Lewis (1964), working for the Council, subjects were dressed in ventilated suits that allowed body temperature to be maintained at any desired level. As the body temperature was raised above normal, their performance in a simple task of detecting signals improved; but in a more complex task of mental arithmetic their performance deteriorated, which is in keeping with the concept of an optimum or normal level of arousal from which departures in one direction or the other produce inefficiency. It would be plausible, and consistent with other findings, that a moderate level of arousal would be best for the complex task and a higher than normal level for the simple task, in which errors are less likely but in which concentration tends to lapse in normal conditions. On the other hand, exposure to hot conditions of the more usual sort, when the body temperature is allowed to take up the level which the body's own mechanisms determine, has no such simple effects on working efficiency. It may be that high body temperature under such conditions is associated with inefficiency even in a simple signal-detecting task, as has been

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found by Bell, Provins and Hiorns (1964). Despite the large number of experiments in this field therefore the effects of heat remain imperfectly understood and a topic of great interest.

The effects of over-arousal

For the reasons already given, it seems that the inefficiency of a sleepless man is due to too low a general level of arousal, and that the effect of noise is to counteract this drop in general activity. There remains the question why inefficiency should appear in over-aroused states, for example in noisy conditions when a person has slept normally, even where incentives are high. Such inefficiency may appear in a variety of highly exciting conditions, which may be presumed to involve over-arousal. A particularly dramatic series of studies has been performed by Berkun and his colleagues (1962), working for the United States Army, who studied the efficiency of soldiers at tasks performed in realistic frightening situations; the time taken to mend a radio set, for example, was measured when the soldiers thought themselves to be under unintended artillery fire during an exercise, and considerable impairment was seen—as is indeed commonly reported in naturally occurring situations of danger.

One widely held view of the sources of this inefficiency, which has been developed by Spence (1956) in the United States, is that the excessively highly motivated or excited individual tends to perform the action that is most natural at the time or has been most practised, even if it happens to be incorrect. On such a view simple tasks, in which the correct action is immediate and natural, are assisted by a high level of excitement, while performance in complex ones, in which an error may momentarily seem the most obvious action, may deteriorate. An experiment by Glucksberg (1962) of New York University showed that a problem with an obvious solution was best solved by men who were competing for a financial prize, but such a prize was a positive hindrance to people who were trying to solve a problem in which the correct answer was not obvious.

* * *

The present state of knowledge thus contradicts both those who regard any discomforts as automatically bad for work and those who treat them as beneath notice. The common-sense view that all stresses are alike in their effect also fails to fit the facts. There does, however, seem to be evidence for a general state of alertness or responsiveness, affected by the rate and intensity of stimulation, by incentives, and by sleep or its deprivation; and this hypothesis perhaps is not at variance with common-sense.

This is certainly too simple an account of the effects of stress. It does not, for example, explain why many stresses produce the oscillatory form of behaviour already mentioned, in which moments of inefficiency are interspersed with periods of normal or supernormal work. Further insight into this problem will depend upon more sophisticated methods of scoring performance, since the average over a period may provide too crude a picture; and much is to be hoped for from the current use in many laboratories of advanced methods of data processing and computer analysis. An increased use of physiological measures in association with psychological ones is also a hopeful trend. The problem of heat needs further analysis, and the experimental use of other stresses in

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addition to the limited range already employed may illuminate the shortcomings of present theories. Nevertheless, a basis has been laid for understanding the factors that make a man work well in some conditions and badly in others.

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ACCIDENTS

In Great Britain deaths caused by accidents are easily outnumbered, in the population as a whole, by those resulting from cardiovascular, respiratory and malignant diseases; but in childhood and early adult life the opposite is now true. Between the ages of one and forty years accidents are the commonest single cause of death. This predominance is due partly to the decline in the number of deaths from infectious diseases, particularly tuberculosis, but deaths due to accidents have themselves increased by 25 per cent in the last ten years —four times the increase in population in the same period. As recently as 1952 infectious diseases killed about as many persons in Great Britain as did accidents (each about 16 000 in the course of the year); in 1962 accidents killed more than three times as many (21 000) as did infectious diseases (6 000). Apart from deaths there are many non-fatal injuries: perhaps twenty times as many severe injuries requiring in-patient hospital treatment as there are deaths, slight injuries being several times as frequent as severe injuries. However, in the absence of standard methods of notification for all injuries comparisons must be restricted to death rates.

Most accidents fall into the broad categories of domestic, 'transport' or occupational. Accidents in the home account for about half the total deaths, transport accidents for about one-third and occupational for about one-fifteenth.

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The hazards at different ages are very different within and between these main categories. For instance among adult factory workers the likelihood of a fatal accident on the road is about three times that of an accident at work. Fatal domestic accidents on the other hand chiefly involve children and old persons beyond the usual limit of working life; about half the total number of deaths in this category occur in persons over 65 years of age, and they are increasing rapidly as a greater proportion of the population survives to old age. There are 50 per cent more fatal accidents in the home now than there were ten years ago, falls being the commonest cause. (See Gray, 1966.)

Most of the fatal transport accidents occur on the roads. About 40 per cent of road traffic deaths are of pedestrians, the highest rates being in children and the old; another 30 per cent are of car occupants (mostly adults), and about 20 per cent are of motor cyclists, predominantly males in their teens and early twenties. The remaining 10 per cent are accounted for mainly by pedal cyclists.

In spite of the great increase in mechanization in industry, fatal industrial accidents represent the one category which has tended to diminish rather than increase in recent years. Although moving machinery is an important source of accidents, even in factories falls are a commoner cause of death; they are also of course particularly prominent among workers engaged in building and engineering construction.

Environmental factors

Accidents can usefully be regarded as the result of multiple causes. This is consistent both with the general view of ' risk ' or ' chance ' that is appropriate for actuarial purposes and with what at first sight seems the contrary view, that the chain of causation is open to investigation and modification. Biological and medical research has helped to throw light on why accidents happen and how they can be prevented.

The early work of the Council's Industrial Fatigue (later Health) Research Board provided a large amount of information about the general predisposing factors. Accident rates in mines and factories are higher at extremes of temperature and where humidity is high than under intermediate conditions; the temperature at which the incidence of accidents is lowest is about 19°C, and recent studies (Department of Scientific and Industrial Research, 1963) have shown that it is approximately at this temperature that vehicle-driving tasks are most efficiently performed (see also the article ' Human Efficiency in Unpleasant Conditions ' on p. 68 of this report). Good lighting reduces accidents in factories, mines and docks, and good street lighting has been shown to reduce road accidents by 30 per cent, while badly lit stairways and passages are frequently a concomitant of accidents in the home.

The relation of the road environment to accidents has been studied by a ' before and after ' technique. Modifications of road conditions are often expensive and do not lend themselves to most techniques of controlled observation, but if there are adequate records of accident frequency before a change such as an alteration of the curvature of a corner is made, the accident rate after the change can be validly compared with the earlier data, particularly if several similar alterations are studied elsewhere. Such investigations cost very little and produce valuable information for the assessment of the benefits likely to accrue from similar changes to other roads.

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Accidents due to exposure and exhaustion are particularly the concern of medical research, and previous work by Council staff at the National Institute for Medical Research helped to elucidate the causes of death in a recent hill-walking competition (Pugh, 1964). The recommendations made should help to prevent such accidents in the future.

Personal factors

Liability to accidents has been found to vary with age, education, experience and marital status (Borkenstein *et al.*, 1964); however, when all such factors are taken into consideration, an underlying 'accident proneness' can still be demonstrated in certain people, though there has been much dispute about its importance and stability (see review by Froggatt and Smiley, 1964). Conditions suitable for the investigation of this proneness are rather rare since unequal exposure to risk is the rule in most situations in which accidents occur. Studies of miners showed an interesting difference in the nature of the accident proneness of the young and older workers: the young accident-prone miners tended not to be aware of a hazard, whereas older accident-prone workers tended to be deficient in their speed of motor reaction (Whitfield, 1954). This suggests that further training of the younger workers should improve their accident record; transfer to intrinsically safer work would probably be more appropriate for the older men. Personal factors in road accidents have been studied among drivers of public service vehicles, where routes travelled, times of day and other variables can be accurately matched. The results have been somewhat contradictory: work in Finland indicated a persistent proneness that correlated fairly well with traits revealed by certain psychological tests (Häkkinen, 1958); a more recent study in Belfast appears to show that there is a temporarily increased liability more often than any stable accident proneness. Studies of bus drivers in London have thrown light on the relative importance of age and experience; for instance, liability to accidents was shown to rise somewhat towards the end of working life, but it was concluded that replacement of older workers by the young and inexperienced would be likely to increase rather than reduce accidents.

Other personal factors in the causation of accidents include illness and disability (Norman, 1960). Sudden collapse while driving is an occasional cause of traffic accidents, and attacks of unconsciousness due to such diseases as epilepsy are a fairly common cause of burns. Investigations of falls in elderly persons (Sheldon, 1960) have shown that these are often due to 'drop attacks' in which there is a sudden loss of muscular power. This is probably caused by cerebral anoxia following narrowing or obstruction of the basilar or vertebral arteries; such attacks may be provoked by turning the head upwards, and an important corollary is that high shelves and cupboards should be eliminated from homes for the elderly.

Experiments on the effects of alcohol have demonstrated that significant impairment of driving skills results even from amounts not causing clinical intoxication (Drew, Colquhoun and Long, 1959). Other experiments have confirmed that this deterioration of driving ability is associated with impairment of judgment, which may lead the driver to take unreasonable risks (Cohen, Dearnaley and Hansel, 1958). Several American studies have shown that it is possible to make reliable field assessments of the effect of alcohol on the incidence of road accidents by making observations on persons not involved in accidents as well as on those who have had accidents, and comparing alcohol levels in the two

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groups. The results confirm that there are significantly increased rates of accident and injury among both drivers and pedestrians who have more than a very moderate level of alcohol in the blood. (See Haddon *et al.*, 1961; McCarroll and Haddon, 1962.)

Recent studies of the detailed psychological processes involved in the driving task may throw light on factors leading to road accidents (Brown and Poulton, 1961). On the basis of communication theory it is suggested that even a normal driver has a limited ' channel capacity ' for the number of lines of information and the number of tasks that can be dealt with per unit of time. The degree of loading of channel capacity in practical driving situations can be measured by the degree of ' spare capacity ' to do another job at the same time, and this approach promises to be applicable both to tests of personal variation in capacity and to studies on the difficulty of the psychological tasks involved.

Factors predisposing to accidents often have both environmental and personal aspects. Long working hours may be regarded as an environmental cause of high accident rates, but the accompanying fatigue can equally be considered the salient factor. More subtle interrelations have been suggested in a study of road accidents in children, where a higher incidence is found when there is illness in the family or other cause of preoccupation in the mother (Backett and Johnston, 1959).

Practical results of research

The background of information that has been built up on the distribution of the various types of accidents in the population and on the general predisposing factors has helped to define fields where preventive measures can be taken.

A very profitable approach has been to study a group of accidents in detail, since knowledge of the circumstances and mechanisms of an injury can provide a basis for the specification of safety measures. Such investigation involves many disciplines besides medicine, and the application of results often demands administrative action; thus the Road Research Laboratory and the Fire Research Station as well as the Medical Research Council have taken part in research of this kind, whilst the organizational and administrative aspects are frequently the concern not only of Government Departments but also of the British Standards Institution. The first stage in the development of a safety device is to ensure its effectiveness in providing the required protection under experimental conditions; further testing is then necessary to see whether it is practicable for general use and finally observations are made to determine whether in fact it does have the effect of reducing accidents and injuries. Technical development has gone hand in hand with the drawing up of standards designed to ensure that devices and materials put on the market have the required performance characteristics.

An early example of such research was the wartime study of head injuries among despatch riders, carried out in Oxford (Cairns, 1941). This gave a rational basis for the design of crash helmets and led to the development of a practical standard, which is now in general use. It is hoped that current research will further improve this design. Several other studies of specific groups of accidents have recently been rewarding. Among road accidents, injuries to the occupants of vehicles are increasing in number and offer the most scope for preventive action. Detailed studies have shown that injuries are caused in three

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ways: by the occupants' continued forward movement after the sudden deceleration of the vehicle, by crushing of the passenger compartment and by ejection of the occupants from the vehicle. Largely as a result of the greater speeds, fatal accidents on motorways have been found to involve more serious and more numerous injuries than do other fatal road accidents (Gissane and Bull, 1964). Direct studies of accidents can often be usefully reinforced by laboratory experiments on the likely mechanism, and in the case of road accidents experiments designed to elucidate the mechanical properties of the tissues involved have helped to demonstrate the mechanisms of fractures and of head and chest injuries. Knowledge of biomechanical tolerance limits, together with information derived from the more general investigations, has provided a basis for rational development of safety harness for cars; and comparisons of the injuries suffered by persons who used and those who did not use this equipment have fully demonstrated its protective value against common injuries caused by momentum and ejection (Lister and Milsom, 1963).

Among domestic accidents, burns are a clearly defined group particularly common and severe in children. Detailed study by members of the Council's Industrial Injuries and Burns Research Unit of the patients treated at the Birmingham Accident Hospital has demonstrated that the accident is frequently caused by clothes that catch fire, and the particular fabrics and types of clothing most often involved have been defined (Bull, Jackson and Walton, 1964). Laboratory tests have been made on the flammability of fabrics involved in burning accidents, and the amount of heat produced in their combustion has been compared with the amounts shown in other experiments to be sufficient to cause severe burns. Thus on the basis of medical studies of burns and technical studies on the flammability of fabrics and on methods of fireproofing, it has been possible to devise specifications for non-flammable fabrics, and there is now legislation enforcing these standards for children's nightwear. Standards for adequate fireguards and for safer oil heaters have had similar histories; and it may be expected that many more of the current problems posed by accidents will be solved by this combination of medical, technical and administrative approaches, in much the same way as were the public health problems of a century ago.

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RESEARCH SUPPORTED BY THE MEDICAL RESEARCH COUNCIL

The following section of the report takes the form of a handbook providing information about the activities of Council establishments—the National Institute for Medical Research and the Council's research units—and of members of their external scientific staff. In each case the summaries of research are preceded by lists of staff employed by the Council and of others who have worked in association with the establishment in question. In addition to members of the Council's scientific staff, these lists include, under the heading 'Other senior staff,' the names of those working in the following categories: Senior Technical Officers; Technical Officers; Chief Technicians II; Technical Research Assistants (Higher); Senior Executive Officers and Higher Executive Officers (including library staff of equivalent grades).

After the lists of the Council's own establishments and external staff information is given, in summary form, about other projects supported by the Council under various schemes of grants and training awards—namely, institutions assisted by block grants, research groups, short-term research grants, fellowships and scholarships.

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C. D. Ginger, Ph.D.*
D. J. Hockley, B.Sc.
Mrs. V. E. Jones, Ph.D.
S. R. Smithers, Ph.D.
G. A. T. Targett, Ph.D. (*until Sept. 1964*)
P. J. Walker, Ph.D. (*until Sept. 1964*)
D. C. Warhurst, Ph.D.
J. Williamson, Ph.D.
R. J. M. Wilson, Ph.D.†

* On leave of absence at University of Massachusetts.
† On leave of absence at Harvard University.

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Other senior staff

M. J. Worms, B.Sc.

Visiting and attached workers

P. C. Basu, M.B. (*WHO Fellow*)
R. D. Bigalke, B.V.Sc. (*Government of South Africa*)
A. R. Njogu, B.Sc. (*Makerere College, Uganda*)
Miss B. M. Ogilvie, Ph.D. (*Wellcome Trust Fellow*)
R. J. Terry, Ph.D. (*S.E. Essex Technical College*)

BIOLOGICAL STANDARDS

Scientific staff

D. R. Bangham, M.B. (*Head of Division*)
S. G. Anderson, M.D., D.Sc.
Miss J. M. Bond, Ph.D.
Miss P. M. Cotes, M.B., Ph.D.
V. Houba, Dr.Med., C.Sc.M.
Mrs. M. Kogut, Ph.D.
J. W. Lightbown, M.Sc., Dip.Bact.
Miss M. V. Mussett, B.Sc.
J. A. Parsons, B.M., B.A.
M. P. Stack-Dunne, Ph.D.
P. L. Walton, Ph.D.
Miss P. M. Woodward, B.Sc.

Other senior staff

L. Ward
K. R. Hobbs

Visiting workers

Miss P. Papasaratorn, B.Sc. (*Colombo Plan Fellow*)
K. U. Rahman, M.B. (*Colombo Plan Trainee*)

IMMUNOLOGICAL PRODUCTS CONTROL

(*at the MRC Laboratories, Holly Hill, Hampstead, N.W.3*)

Scientific staff

F. T. Perkins, Ph.D. (*Head of Division*)
L. R. Boulger, M.B.
L. D. Brookes, B.M.
Miss M. Clarke, M.B., D.C.H.
E. G. Hartley, M.R.C.V.S.
L. F. Hewitt, D.Sc., F.R.I.C.
Mrs. M. C. Holness, B.Sc.
J. P. Jacobs, M.A.
D. I. Magrath, Ph.D.
T. W. Osborn, M.B.
Miss G. R. Paton, B.Sc.
G. Sander, M.D.
F. W. Sheffield, M.B.
Miss M. A. Westwood, Ph.D.
Miss M. M. Winter, M.B. (*until Dec. 1964*)
Miss R. A. Yetts, B.Sc.

Other senior staff

H. Ward

Visiting and attached workers

E. Ferreira, M.D. (*Government of Portugal grant-holder*)
Miss M. H. Imboden (*Ciba, Basle*)
Miss M. Nilsson (*Karolinska Institute, Stockholm*)
B. F. Reeves, M.B., F.R.C.S., D.R.C.O.G. (*Royal College of Surgeons*)

ENGINEERING

Scientific staff

W. C. Lister, B.Sc., M.I.E.E., F.Inst.P. (*Head of Division*)
J. Edwards, M.Sc.
B. C. Elford, B.Sc.
N. L. Gregory, M.Sc., A.R.C.S.
W. J. Perkins, M.I.E.E., M.I.E.R.E.
B. M. Wright, M.B.

Other senior staff

R. B. Bower, A.I.S.T.
C. F. Doré
B. J. Hammond, Grad.I.E.E., Grad.Brit.I.R.E., Grad.Inst.P.
J. E. Lewin, Grad.Brit.I.R.E.
D. W. Lywood, B.Sc. (*until Aug. 1964*)
M. McDonald, B.Sc. (*until Oct. 1964*)
E. A. Piper
L. L. Woodget

Attached worker

F. G. Tattam, M.E. (*Wellcome Trust Research Fellow*)

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ANIMAL DIVISION

Scientific staff

A. W. Gledhill, Sc.D., M.R.C.V.S. (*Head of Division*)

Other senior staff

D. J. Short, M.B.E.

Visiting worker

D. L. J. Bilbey, M.B., Ph.D. (*King's College, London*)

LABORATORY OF HUMAN BIOMECHANICS

(*at the MRC Laboratories, Holly Hill, Hampstead, N.W.3*)

Scientific staff

R. J. Whitney, Ph.D. (*Head of Laboratory*) D. W. Grieve, Ph.D.

Other senior staff

Mrs. R. J. Gear

Attached worker

A. Laville, M.D. (*Laboratoire de Physiologie de Travail, Paris*)

WORKS AND MAINTENANCE

J. Cree (*Building Superintendent*)

LIBRARY

L. T. Morton, F.L.A. (*Librarian*)

Mrs. R. E. Arnstein, B.A., A.L.A.
Miss M. Harvey, B.A., B.L.S. (*until Feb. 1965*)*

ADMINISTRATIVE STAFF

J. H. Platts (*Finance Officer*)
L. J. Hale (*Personnel Officer*)

Miss P. M. Townend (*Director's Secretary*)

MEDICAL RESEARCH COUNCIL LABORATORIES

(*Holly Hill, Hampstead, London, N.W.3: Hampstead 2232*)

Mrs. M. E. A. Lang (*Administration*)

J. C. Tyler (*Maintenance engineer*)

The work of the Institute is generally designed to cover as wide a field as possible in basic non-clinical medical research, and is mostly of a long-term character. In some instances, such as the research on the common cold, the work verges on the clinical field, and members of the scientific staff at the Institute commonly collaborate in clinical developments arising from their discoveries. Certain major themes, such as the mechanisms of protein synthesis, the actions of viruses on cells, and the nature and control of the immunological response, are constantly under study; sometimes, as in the case of the Division of Human Physiology where the main task is to investigate the effects of extremes of temperature on human performance, a fairly closely defined field of research may be pursued; for the rest, the direction that the work takes is largely determined by the particular interests of the senior members of the staff. This principle is at present illustrated by investigations on the growth of leprosy organisms, the storage of tissues, the action of pharmacological agents infused into the cavity of the brain, and many others besides.

Although for administrative purposes the Institute is organized in separate divisions, there is a large measure of collaboration in the attack on problems requiring more than one technique for their solution. Moreover, special tasks such as those relating to biological standards and the epidemiology of influenza,

* Miss Harvey transferred to the Clinical Research Centre in February 1965.

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which the Council undertake for the World Health Organization, are interwoven with the normal research activities of appropriate divisions throughout the Institute. For these reasons, the researches enumerated in the following summary often represent the joint work of members of more than one division; the summary is, in fact, constructed on a scientific and not on an administrative basis.

Summary of research

BIOCHEMISTRY

1. Protein biosynthesis:
   (*a*) Mechanism of haemoglobin synthesis by isolated reticulocyte ribosomes.
   (*b*) Protein synthesis by isolated mitochondria.
   (*c*) Induction of protein synthesis by purified ribonucleic acid (messenger RNA).
   (*d*) Control of rate of protein synthesis at the ribosome level.
2. Protein structure:
   (*a*) Methods for specific rupture of peptide chains.
   (*b*) Chemical modification of biologically active peptides.
   (*c*) Specific interaction between peptides and proteins.
   (*d*) Quantitative amino acid analysis of proteins.
3. Nucleic acids:
   (*a*) Purification of messenger RNA from reticulocytes.
   (*b*) Base sequence determinations in RNA.
   (*c*) Physico-chemical studies on various types of RNA.
4. Hormones:
   (*a*) Influence of thyroxine on rate of RNA synthesis in intact animals.
   (*b*) Control of level of RNA-polymerases by hormones.
   (*c*) Enzyme changes in amphibians following hormone-induced metamorphosis.
   (*d*) Purification of neurohormones from the median eminence of the hypothalamus.
5. Biochemistry of virus replication:
   (*a*) Localization of the site of formation of virus RNA in cells infected with EMC virus.
   (*b*) Localization of the site of synthesis of virus protein in infected cells.
   (*c*) Synthesis of a specific RNA-polymerase in virus-infected cells.
   (*d*) Synthesis of virus nucleic acid in cell-free systems.
6. Subcellular organelles:
   (*a*) Improved methods for preparation of mitochondria.
   (*b*) Methods for fractionation of ribosomal proteins.
   (*c*) Interaction between ribosomes and RNA.
   (*d*) Effects of hormones on subcellular morphology.

BIOPHYSICS

1. Physical characterization of proteins:
   (*a*) Electron microscopy of catalase molecules.
   (*b*) Improved techniques for measuring molecular weights of proteins and other substances in the ultracentrifuge.
   (*c*) Ultracentrifugal classification of antibodies produced in monkeys in response to worm infections.
   (*d*) Molecular weights of bacterial penicillinases.
2. Metabolism of plasma proteins:
   (*a*) Effects of regeneration, carcinogens and dietary deficiency on protein synthesis by the perfused liver.
   (*b*) Investigation of plasma colloid osmotic pressures in relation to rates of catabolism of albumin.
   (*c*) Measurement of rates of synthesis of liver-produced proteins in man and animals.
   (*d*) Metabolic aspects of the defibrination syndrome that follows injection of snake venom.
   (*e*) Clinical studies of haptoglobin metabolism in severe anaemias.
3. Electron microscopic studies of bacteria and viruses.
4. Isotopic studies of urea metabolism in man and animals.
5. Characteristics of photographic emulsions used for electron microscopy.
6. Euchrysine as a stain in fluorescence microscopy.

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1. Filariasis:
   (*a*) Periodicity of microfilariae and the diurnal temperature cycle in monkeys and dogs.
   (*b*) Effects of adapting a monkey to a 28-hour day.
   (*c*) Control of human filariasis by drugs.
   (*d*) Filariasis in British wild birds and African mongooses.
2. Malaria:
   (*a*) Immunology of protective vaccines from *Plasmodium knowlesi* and *P. berghei*.
   (*b*) Development and nature of drug resistance to chloroquine.
   (*c*) Attempts to cultivate endoerythrocytic forms of *Plasmodium in vitro*.
3. Schistosomiasis and other helminthic infections:
   (*a*) Mechanism of resistance to the lung worm (*Dictyocaulus viviparus*) in guinea pigs.
   (*b*) Identification of protective antibodies against *Nippostrongylus*, *Schistosoma* and *Haemonchus*.
   (*c*) Chemical and physical studies on helminth antigens.
   (*d*) Characterization of polysaccharide antigen in eggs and cercariae of *S. mansoni*.
4. Trypanosomiasis:
   (*a*) Development of drug resistance and its genetic basis.
   (*b*) Immunology of African pathogenic trypanosomes.
   (*c*) Electron microscopic analysis of the uptake of macromolecules.
   (*d*) Hypersensitivity of suramin-resistant trypanosomes to puromycin and its amino-nucleoside; synergic action of suramin and puromycin.
   (*e*) Effects of trypanocidal drugs on the fine structure of trypanosomes.
   (*f*) Ribonuclease activity in normal and drug-treated trypanosomes.
   (*g*) Trypanosome phospholipids as drug acceptors; thin-layer chromatographic patterns of protozoal lipids.
   (*h*) Attempted induction of infectivity in culture forms of trypanosomes.

ORGANIC CHEMISTRY

1. Biosynthesis of thiamine.
2. Chemistry of the antibiotic micrococcin P.
3. Chemistry of thiazoles and thiazolines.
4. Improvements in chromatographic techniques.
5. Physico-chemical studies on salts of amidines with carboxylic acids.
6. Haemoglobin:
   (*a*) Quantitative characterization of haemoglobin variants in selected clinical material.
   (*b*) Chemical and physical studies of haemoglobins.
   (*c*) Study of genetically determined unstable haemoglobin variants.
   (*d*) Non-haemoglobin proteins in red cells.
7. Preparation, purification and quantitative spectroscopic characterization of model compounds and proteins.
8. Spectroscopic study of structural perturbations of proteins and related compounds.
9. Antihistaminic compounds in plant tissues.
10. Metabolism of vitamin D.
11. Chemical releasers and pheromones of Apidae.
12. Synthesis of plasmalogens.
13. Synthesis of derivatives of muramic acid.
14. New syntheses of amino sugars.
15. Gas chromatographic analysis of aromatic chlorination products.
16. Chemical structure of the cell wall of *Bacillus subtilis*.

BACTERIOLOGY, BACTERIAL PHYSIOLOGY AND ANTIBIOTICS

1. Penicillinases:
   (*a*) Bacterial penicillinases and factors controlling their structures and rates of production.
   (*b*) Genetic analysis of pencillinase formation in *Staphylococcus aureus* and *Bacillus licheniformis*.
   (*c*) Mechanism of extracellular enzyme secretion from bacteria.
   (*d*) Investigation of enzymic activities of single cells.
2. Bacterial cell walls:
   (*a*) Control of the biosynthesis of cell surface components, including mucopeptide.
   (*b*) Structure of cell wall mucopeptides of *Clostridium welchii* and *Micrococcus lysodeikticus*.

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3. Control of metabolism in micro-organisms:
   (*a*) Role of induction and repression in regulating the synthesis of enzymes degrading aromatic compounds in *Pseudomonas*.
   (*b*) General study of protein degradation in *Escherichia coli*.
4. Theory and application of numerical taxonomy.
5. Leprosy:
   (*a*) Cultivation of mouse leprosy bacillus (*Mycobacterium lepraemurium*) in tissue cultures; attempted cultivation in cell-free media.
   (*b*) Attempts to cultivate human leprosy bacillus (*Myco. leprae*) in tissue cultures.
   (*c*) Electron microscopy of the host–parasite relationship in murine leprosy.
   (*d*) Experimental human leprosy in the mouse and hamster.
   (*e*) Peripheral nerve involvement in experimental and human leprosy.
   (*f*) Antigenic and cell wall constituents of *Myco. lepraemurium* and *Myco. leprae*.
   (*g*) Chemotherapy of leprosy carried out in Sungei Buloh Leprosarium, Malaysia.
6. Other mycobacteria:
   (*a*) Isolation of mycobacteria from patients with skin ulcers.
   (*b*) Action of a riminophenazine derivative (B.663) on *Myco. ulcerans*.
7. Attempts to produce sarcoidosis in animals.
8. Antibiotics:
   (*a*) Isolation and investigation of antibiotics from soil bacteria.
   (*b*) Mode of action of streptomycin.
   (*c*) Mode of action of penicillins and other antibiotics interfering with biosynthesis of cell walls.
   (*d*) Evolution of resistance to new antibiotics.

VIRUS RESEARCH

1. Viruses and carcinogenesis:
   (*a*) Antigens present in adenovirus-induced tumours.
   (*b*) Increased susceptibility to virus-induced tumours by injection of antibody.
   (*c*) Thymectomy and increased susceptibility to infection and tumour production by adenoviruses.
   (*d*) Increased resistance to virus-induced tumours by injection of lymphoid cells.
2. Adenoviruses and bovine respiratory infection.
3. Genetics of influenza viruses.
4. Common cold:
   (*a*) The spread of respiratory virus infections in man.
   (*b*) Antigenic studies of rhinoviruses and respiratory syncytial viruses.
   (*c*) Attempts to cultivate new common cold viruses.
   (*d*) Physico-chemical properties of common cold viruses.
   (*e*) Purification and concentration of common cold viruses.
   (*f*) Antibodies to respiratory viruses in individuals from Tristan da Cunha.
   (*g*) Growth of respiratory viruses in organ cultures.
   (*h*) Effect of an antiviral substance on influenza in volunteers.
5. Interferon:
   (*a*) Production and mode of action of interferon.
   (*b*) Effect of interferon on metabolism of uninfected cells.
   (*c*) Relationship between interferon and viral interference.
6. Growth of mouse hepatitis virus in tissue culture.
7. Pathogenesis of murine virus diseases, particularly leukaemias and latent infections.
8. Epidemiology of ectromelia in mice.
9. Growth of arboviruses in cultured mosquito tissues.
10. Isolation of rubella virus from a human embryo.
11. Development of mice infected *in utero* with lymphocytic choriomeningitis virus; pathogenesis of LCM infection in guinea pigs.
12. Electron microscopic characterization of bovine malignant catarrhal fever virus.
13. Ultrastructure of the infectious agents of the psittacosis–lymphogranuloma–trachoma group.
14. World Health Organization reference laboratory investigations with influenza and other respiratory viruses and arboviruses.

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1. Mechanism of cell damage by complement.
2. Fate of radioactively labelled antigens and haptens in relation to antibody production and induction of tolerance.
3. Mechanisms of tolerance in humoral immunity and delayed-type hypersensitivity.
4. Immunological response systems:
   (*a*) Cell types involved in antibody formation.
   (*b*) Functions of the thymus.
   (*c*) Life span of immunologically competent cells.
   (*d*) Sensitization of macrophages in delayed-type hypersensitivity.
5. Experimental auto-immunization against gut components.
6. Genetic control of specific antibody responses.
7. Tissue transplantation:
   (*a*) Normal lymphocyte transfer reaction and its histological analysis.
   (*b*) Effects of radiation on immunological competence.
   (*c*) Induction of tolerance in adults.
   (*d*) Chemistry of antigens.
   (*e*) Transformations induced by ribonucleic acids.
8. Antibody production by cells in diffusion chambers.
9. Investigation of immunization schedules in infants.
10. Development of immunity in foetal Rhesus monkeys.

BIOLOGY, CYTOLOGY AND PATHOLOGY

1. Freezing and storage of tissue:
   (*a*) Pharmacology of protective agents.
   (*b*) Orthotopic grafting of hyaline cartilage.
2. Transplacental transfer in Rhesus monkey.
3. Physiology of erythropoietin secretion.
4. Isolation and pharmacological study of insect toxins.
5. Lysosomes:
   (*a*) Activation of lysosomal enzymes in virus-infected cells.
   (*b*) Concentration of carcinogenic and fluorescent drugs in lysosomes.
6. Electron donation and acceptance by molecules of biological importance.
7. Relationship of glucose-6-phosphate deficiency to cataract.
8. Cytology of pituitary gland of the Patas monkey.

PHYSIOLOGY AND PHARMACOLOGY

1. Neural control of the release of vasopressin and oxytocin.
2. Inhibition of oxytocin by its analogues.
3. Role of amines in the hypothalamic control of body temperature.
4. Drugs acting from the cerebral ventricles.
5. Release of acetylcholine from the brain.
6. Absorption of adrenaline from the subarachnoid space.
7. Regions of the brain stem involved in the defence reaction.
8. Effects of bradykinin, angiotensin and renin on suprarenal medulla and sympathetic ganglia.
9. Histamine uptake and formation by animal tissue.
10. Effects of pH on electrical and mechanical properties of heart and skeletal muscle.

HUMAN PHYSIOLOGY AND BIOMECHANICS

1. Heat acclimatization in man: physiological responses to controlled hyperthermia.
2. Environmental studies in Antarctica.
3. Diurnal rhythms:
   (*a*) in psychosis and neurosis;
   (*b*) in shift work;
   (*c*) effects of activity and light (with studies in blind subjects).

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4. Peripheral circulation in man:
   (*a*) in skin grafts;
   (*b*) in skin diseases;
   (*c*) effects of temperature.
5. Effects of exercise: measurement of cardiac output and oxygen consumption.
6. Biomechanics of standing and sitting postures.
7. Analysis of complex movements of work and athletics (simultaneous use of force analysis platform, cinephotography and electromyography).
8. Biomechanics of human locomotion during infancy and adolescence, and comparison with adult locomotion.
9. Effects of prolonged inactivity and sitting on muscular function.

BIOLOGICAL STANDARDS AND CONTROL OF IMMUNOLOGICAL PRODUCTS

1. Advisory and control work for the Ministry of Health (Therapeutic Substances Act), including revision of regulations.
2. Advisory work for the British Pharmacopoeia Commission, including preparation of monographs.
3. Standards and reference preparations:
   (*a*) Preparative and assay work towards establishment of 40 international and 20 British national or research standards or reference preparations.
   (*b*) Standardization of penicillin PAM preparations on behalf of WHO anti-yaws campaign.
4. Relative assessment of different penicillins and penicillin preparations on the basis of *in vitro* and *in vivo* experiments.
5. Methods of assay of streptokinase, urokinase and other activators of the fibrinolytic system.
6. Method of assay and characterization of heparins of various origins.
7. Methods of assay and characterization of pituitary hormones.
8. Control testing of inactivated poliomyelitis vaccine, oral poliomyelitis vaccines and of influenza, smallpox and BCG vaccines.
9. Development of new or improved systems for control of measles, rubella and pertussis vaccines.
10. Assessment of neurovirulence of poliomyelitis virus.
11. Tissue culture:
   (*a*) Provision of national tissue culture service.
   (*b*) Investigation of human diploid cell cultures for preparation of virus vaccines.
   (*c*) Karyology of human diploid cell strains.

INSTRUMENTATION AND BIOENGINEERING

1. Use of analogue computers in the study of various biological performances.
2. Development of particle-counting methods.
3. Measurement of alcohol in breath.
4. Design and construction of special instruments, including tension measurement, coagulometry, slow injection, cartilage grafting, peristaltic pumps, miniature pressure reduction valves.
5. Electron–molecule reaction studies extended to biologically active materials.
6. Development of fully automatic patient monitoring system.
7. Radio aids for survival at sea.
8. Development of methods for long-term implantation of ' radio pills '.
9. Design of implantable EEG radio transmitter for small animals.
10. Development of very small recording instruments to measure simple environmental and physiological variables on ordinary members of the population.

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Research Units

One of the chief means adopted by the Council for the long-term support of research has been the creation of research units in which they employ their own staff. The principle determining the establishment of units is that scientists of proven ability should be given the opportunity of leading a team working, within fairly wide terms of reference, in a particular field. Such units may be set up to further research into new subjects not yet appropriate for inclusion in the university framework, or to develop subjects which require support on a scale beyond the resources of a university or hospital or which have been hitherto neglected.

The majority of the Council's units are situated within or in close proximity to a university or hospital, but they are normally independent of the host institution both in function and in administration.

DEPARTMENT OF CLINICAL RESEARCH

University College Hospital Medical School, University Street, London W.C.1
(Euston 5861)

Director
E. E. Pochin, C.B.E., M.D., F.R.C.P.*

Scientific staff

C. F. Barnaby, Ph.D.
E. R. Beck, M.B., M.R.C.P.
C. J. Edmonds, M.D., M.R.C.P.
D. A. W. Edwards, M.D., M.R.C.P.†
B. M. Jasani, M.Sc.
E. N. Rowlands, M.D., B.Sc., F.R.C.P.†
C. T. Stockel, B.Sc.
B. D. Thompson, Ph.D.

Other senior staff
A. G. Cronquist, F.B.H.I.

Visiting workers

O. Nielson, M.D. (*Bispebjerg Hospital, Copenhagen*)
J. E. Scholer, M.D. (*Palo Alto, California*)
Mme. E. Triantaphyllidis, M.D. (*Faculté de Médecine, Paris*)

The Department has clinical opportunities and laboratory facilities for the study of certain diseases and abnormalities, and for investigating methods of their diagnosis and treatment. Present work is concerned particularly with disorders of the thyroid gland and of gastrointestinal function.

Summary of research

1. Thyroid function:
   (*a*) Hormone formation in normal and overactive glands, and the concentration of these hormones and other thyroid metabolites in the liver.
   (*b*) Compounds released during ablation of the gland by radiation.
   (*c*) Treatment of thyroid overactivity with radioactive iodine and review of possible complications of this form of therapy.

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* Salary of post partly met by permanent endowment from Rockefeller Foundation.

† Dr. Rowlands is director of the Council's Gastroenterology Research Unit at the Central Middlesex Hospital, London; Dr. Edwards is also a part-time member of this Unit (p. 92).

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2. Thyroid cancer:
   (*a*) Evaluation of the radioiodine treatment of thyroid cancer, criteria of suitability and indications for completion of treatment.
   (*b*) Assessment of body radiation received during such treatment and of any consequent hazards.
   (*c*) Comparison of metabolites produced by cancer tissue with those from normal and overactive glands.
   (*d*) Relationship between tumour histology, metabolite formation and radioiodine turnover.
   (*e*) Investigation of large-area scintillation counters, liquid and solid, particularly for measurements of whole-body radioactivity.
   (*f*) Development of techniques for measurement of low-level radioactive sources, in particular radioactivity of the human body, and for use in tracer studies.
   (*g*) Determination of the distribution of radioactive sources in the human body that gives rise to the observed distributions of counts.
3. Gastroenterology:
   (*a*) Achalasia, diffuse spasm and the hypertensive cardiac sphincter: manometric and cineradiographic studies.
   (*b*) Applied pharmacology of the oesophagus: manometric and cineradiographic studies.
   (*c*) Mechanisms concerned in the symptoms of hiatus hernia and in gastro-oesophageal reflux, aerophagy and vomiting.
   (*d*) Measurement of gastrointestinal pH and mucosal potential *in situ*.
   (*e*) Mechanisms of anal continence, defaecation and colon transport.
   (*f*) Clinical and radiological studies on the effects of treatment of hiatus hernia and achalasia.
4. Electrolyte distributions: passage of labelled sodium, potassium and other materials across the intestinal wall.

GASTROENTEROLOGY RESEARCH UNIT

Central Middlesex Hospital, Park Royal, London N.W.10
(Elgar 5733)

Director
E. N. Rowlands, M.D., B.Sc., F.R.C.P.*

Scientific staff

A. M. Connell, M.B., B.Sc., M.R.C.P.E. (*until June 1964*)
D. A. W. Edwards, M.D., M.R.C.P.*
T. D. Kellock, M.D., M.R.C.P. (*honorary*)
J. E. Lennard-Jones, M.D., M.R.C.P.
J. J. Misiewicz, M.B., B.Sc.
Mrs. M. Shiner, M.R.C.S., D.C.H. (*part-time*)
T. Smith, M.Sc.
Miss S. L. Waller, M.B., B.Sc.
H. S. Wiggins, Ph.D.

Attached workers

J. H. Baron, D.M., M.R.C.P. (*Middlesex Hospital, London*)
H. B. Cook, M.B., M.R.A.C.P. (*Princess Margaret Hospital, Christchurch, New Zealand*)
F. A. Pontes, M.D. (*University of Coimbra, Portugal*)
S. M. Sherif, D.M., M.R.C.P.E. (*University of Cairo*)
J. D. Townend, M.D. (*Permanente Medical Group, Walnut Creek, California*)

The Unit is studying the motility of the alimentary tract in health and disease, the mechanism of fat absorption, and the pathogenesis and treatment of certain gastrointestinal disorders.

Summary of research

1. Pathogenesis and treatment of achalasia and oesophageal spasm.
2. Gastro-oesophageal reflux, hiatus hernia and aerophagy.

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* Dr. Rowlands and Dr. Edwards work also in the Department of Clinical Research, University College Hospital Medical School, London (p. 91).

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3. Gastric motility in anorexia nervosa.
4. Motility of small intestine in health and disease.
5. Mechanism of colonic symptoms and comparison of motility of proximal and distal colon in health and disease.
6. Mechanism of anal continence.
7. Measurement of gastrointestinal transit time using ^{51}Cr.
8. *In vitro* responses of gastrointestinal smooth muscle removed at operation.
9. Biochemical studies of intraluminal phase of fat absorption and electron microscopy studies of intracellular phase.
10. Correlation of mucosal changes in jejunal biopsies with clinical findings.
11. Assessment of Lundh's pancreatic function test.
12. Investigation of intestinal bacterial flora.
13. Effect of diet on gastric acidity in duodenal ulcer.
14. Effect of gastric freezing in the dog.
15. Measurement of gastric acidity with a pH telemetering capsule.
16. Serum complement levels in ulcerative colitis.
17. Controlled therapeutic trials in ulcerative colitis.
18. Development of ' tubeless ' devices for measuring pressure and pH, for detecting the site of bleeding in gastrointestinal haemorrhage, and for obtaining samples of intestinal contents.

DEPARTMENT OF EXPERIMENTAL MEDICINE

Tennis Court Road,
Cambridge

5 Shaftesbury Road,
Cambridge

(Cambridge 52252)

Director
Professor R. A. McCance, C.B.E., M.D., D.Sc., F.R.C.P., F.R.S.

Assistant Director
Miss E. M. Widdowson, D.Sc.

Scientific staff
J. W. T. Dickerson, Ph.D.
G. C. Kennedy, M.B., Ph.D.
L. Lawn, M.D. (*honorarium*)
M. J. Purves, M.D., M.R.C.P.
D. A. T. Southgate, Ph.D.
Miss M. W. Stanier, D.Phil.
A. E. Thorn, M.B., D.Obst.R.C.O.G.

Other senior staff
R. A. Spires, M.I.S.T.

Visiting and attached workers
Miss H. M. Bruce, B.Sc. (*MRC grant-holder*)
Mrs. P. A. Cavell, B.Sc. (*McGill University, Montreal*)
A. R. Hamad El Nil, M.B. (*University of Khartoum*)
Mrs. K. Ferreira, M.D. (*Santa Maria Hospital, Lisbon*)
D. Lister, B.Sc. (*University of Reading*)
K. J. McCracken, B.Sc., B.Agric. (*MRC Scholar*)
R. N. Misra, M.D. (*University of Lucknow*)
Miss D. M. Nutbourne, M.B. (*MRC Clinical Research Fellow*)
Miss C. W. Rintoul, M.B., M.R.C.P. (*MRC Junior Research Fellow*)
Professor J. R. Robinson, M.D., Ph.D. (*University of Otago, New Zealand*)
P. Schmidt, M.D. (*University of Pécs, Hungary*)
Miss L. Thomas, M.Sc. (*University of Edinburgh*)
Mrs. F. Turner, Ph.D. (*University of London*)
J. M. Walshe, M.B., Sc.D., F.R.C.P. (*University of Cambridge*)

The Department is studying certain aspects of metabolism and nutrition, and in particular the changes which take place during growth and in states of under-nutrition and disease. The work includes studies of normal infants and adults, of patients and of animals.

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Summary of research

1. The effect of development, undernutrition and rehabilitation on the composition of the body, its tissues and its cells in human beings, pigs, poultry and rats.
2. Development of respiratory control in the foetus and newborn infant.
3. Hypothalamic regulation of water and energy expenditure and hormone production.
4. Chemotherapy of diabetes insipidus with chlorothiazide.
5. Relation of overnutrition to growth, to diabetes and to renal disease.
6. Treatment of Paget's disease with fluorides.
7. Food, growth and homoeostasis in the neonatal period.
8. Mineral metabolism in the newborn infant.
9. Renal function of infants and animals before and after birth.
10. Development and use of an artificial placenta.
11. Ion transport in foetal membranes.
12. Copper metabolism in man.
13. Pathogenesis and treatment of Wilson's disease.
14. Food absorption at different ages.
15. Carbohydrate metabolism in the protein-deficient animal.

RHEUMATISM RESEARCH UNIT

Canadian Red Cross Memorial Hospital, Taplow, Maidenhead (Burnham 543)

Honorary Director

Professor E. G. L. Bywaters, M.B., F.R.C.P.

Scientific staff

Miss B. M. Ansell, M.B., M.R.C.P. (*part-time*)
Mrs. P. C. Brown, M.D.
R. Consden, Ph.D., F.R.I.C.
L. E. Glynn, M.D., B.Sc., F.R.C.P.
E. J. Holborow, M.D.
A. Howard, B.Sc.
G. Loewi, D.M.
Miss J. M. Phillips, Ph.D.
J. E. Scott, Ph.D.
D. P. Page Thomas, M.B.
D. J. Ward, M.B., M.R.C.P.

Other senior staff

G. D. Johnson, F.I.M.L.T.

Visiting and attached workers

R. D. Barnes, M.D. (*Guy's Hospital Endowments Fund Fellow*)
G. Bencze, M.D. (*Wellcome Research Fellow*)
E. H. Beutner, Ph.D. (*National Institute of Dental Research Fellow*)
J. E. Boone, M.D. (*Canadian Arthritis and Rheumatism Society grant-holder*)
N. E. Brandstrup, M.D. (*Stanford University*)
M. Espiritu, M.D. (*Colombo Plan Fellow*)
Miss P. A. Evans, M.B. (*Queen Charlotte's Hospital, London*)
C. Fürst, M.D. (*Rheumatism Unit, Bad Ragaz, Switzerland*)
B. J. Hodgkinson, M.B. (*Arthritis and Rheumatism Council grant-holder*)
H. E. Jasin, M.D. (*Nuffield Foundation grant-holder*)
Mrs. E. Kaklamanis, M.D., Ph.D. (*Arthritis and Rheumatism Council grant-holder*)
Ph. Kaklamanis, M.D. (*Council of Europe Fellow*)
D. H. Kearns (*US Public Health Service grant-holder*)
R. M. Kivel (*National Institute of Arthritis and Metabolic Diseases Fellow*)
K. U. Laiho, M.D. (*Finnish Health Service grant-holder*)
W. J. Reynolds, M.D., F.R.C.P.Can. (*Canadian Arthritis and Rheumatism Society Fellow*)
S. D. Roberts, M.D. (*Arthritis and Rheumatism Council grant-holder*)
P. L. Samuelson, B.A. (*Cornell University*)
J. R. Topp, M.D., F.R.C.P.Can. (*Canadian Arthritis and Rheumatism Society Fellow*)
D. Vukotic, M.D. (*British Council Fellow*)
Miss S. F. Whittingham, M.D. (*Australian Red Cross Blood Transfusion Service*)

The Unit is carrying out both clinical and laboratory investigations on the nature, course and treatment of rheumatic diseases; these involve studies of both normal and abnormal connective tissue, with special emphasis on auto-immune reactions.

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Summary of research

1. Changes in connective tissue with age and disease.
2. Use of immunofluorescent methods:
   (*a*) to detect auto-antibodies in human and animal sera;
   (*b*) to study the distribution in the tissues of native and foreign antigens;
   (*c*) to study immune responses at a cellular level.
3. Experimental production of auto-antibodies and auto-immune disease.
4. Nature of immune responses to polysaccharide-containing antigens.
5. Family study of rheumatic fever, systemic lupus erythematosus and Still's disease, with reference to genetic constitution.
6. Long-term surveys of the course of rheumatic fever and rheumatoid arthritis in children.
7. Effects of prophylaxis in the prevention of rheumatic fever recurrences.
8. Controlled therapeutic trials in various connective tissue diseases.

CLINICAL ENDOCRINOLOGY RESEARCH UNIT

2 Forrest Road, Edinburgh 1
(Caledonian 3186)

Director
J. A. Loraine, M.B., D.Sc., F.R.C.P.E.

Scientific staff

W. P. Barnard, B.Sc.
E. T. Bell, Ph.D.
G. P. Crean, M.B., Ph.D., M.R.C.P.E.
Miss M. M. Gordon, B.Sc.
R. A. Harkness, M.B., Ph.D., M.R.C.P.E.
W. M. Hunter, Ph.D.
W. J. Irvine, M.B., B.Sc., M.R.C.P.E.
K. E. Kirkham, Ph.D.
Mrs. M. Krishnamurti, M.B.
E. Menini, Ph.D.
Miss J. K. Rice, Ph.D.
Mrs. P. A. Sadler, M.Sc.
Miss H. E. C. Cargill Thompson, B.Sc.
Miss P. M. Wilson, B.Sc.

Other senior staff

H. A. F. Blair, A.I.S.T., Dip.S.T.A.
D. W. Davidson
D. N. Love
Miss M. A. Mackay, F.A.T.A., A.I.S.T.

Visiting and attached workers

Jean Blyth, B.Sc. (*MRC Scholar*)
Aliza Eshkol (*Tel-Hashomer Hospital, Tel Aviv*)
P. C. Ganguli, M.B., M.R.C.P.E. (*MRC grant-holder*)
A. A. Gunn, M.B., F.R.C.S.E. (*Bangour General Hospital, Edinburgh*)
A. A. A. Ismail, B.Pharm. (*University of Cairo*)
P. L. Llorente, Ph.D. (*Conseso Superior de Investigaciones Cientificas, Madrid*)
H. McFarlane, Ph.D. (*University of the West Indies; Wellcome Trust grant-holder*)
G. Montanino, M.D. (*University of Rome*)
S. Mukhopadhyay, M.B., Ph.D. (*Colombo Plan Fellow*)
D. Newble (*University of Edinburgh*)
W. M. Rigal, M.B., D.Phil., F.R.C.S.E. (*MRC grant-holder*)
D. Schönberg, Dr.Med. (*University of Hamburg*)
P. N. Srivastava, M.Sc. (*Colombo Plan Fellow*)
Pachara Visutakul, M.B. (*Colombo Plan Fellow*)
G. Winkler, M.D. (*Schering Fellow*)

The main interests of the Unit continue to be the development of methods for the quantitative determination of hormones and their metabolities in body fluids, the application of these methods to clinical problems and the relationship of experimental and clinical endocrinology to other medical specialties, with special reference to gastroenterology and auto-immunity.

Summary of research

1. Establishment of a new and very sensitive bioassay method for luteinizing hormone (LH), depending on the depletion of ovarian cholesterol in rats.
2. Assay methods for follicle-stimulating hormone (FSH).
3. Assay methods for human chorionic gonadotrophin with special reference to the development of a radioimmunological procedure.

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4. Effect of urea on the biological activity of various gonadotrophins (with a view to separating FSH from LH).
5. Renal clearance of gonadotrophins in the Equidae.
6. Estimation of LH in body fluids of very young children (with Dr. J. O. Forfar, Western General Hospital, Edinburgh).
7. Effect of various compounds on pituitary function in human subjects as judged by urinary gonadotrophin assays.
8. Establishment of a radioimmunological assay method for the quantitative determination of growth hormone in human peripheral blood.
9. Effect on plasma growth hormone levels of such factors as sleep, food intake, hypoglycaemia and exercise (with Mr. W. M. Rigal, Department of Orthopaedics, University of Edinburgh, and Dr. J. A. Strong, Western General Hospital, Edinburgh).
10. Measurement of plasma growth hormone levels in pathological conditions.
11. Purification of human pituitary thyroid-stimulating hormone (TSH) and its separation from pituitary LH (with Dr. Anne Stockell-Hartree, University of Cambridge).
12. Development of chromatographic techniques for the quantitative determination of thyroid hormones.
13. Investigations into the biological and chemical nature of the long-acting thyroid stimulator (LATS).
14. Comparison of *in vivo* and *in vitro* assay methods for TSH and LATS.
15. Serum TSH levels together with estimations of blood protein-bound iodine in patients with thyroid endocrinopathies and following hypophysectomy and yttrium implantation.
16. Assay methods for oestrogens, progesterone and its metabolites, pregnanetriol and corticosterone with special reference to the development of techniques for the systematic analysis of steroids.
17. Metabolism of radioactive progesterone in human subjects.
18. Various clinical applications of assays of blood and urinary oestrogens, including studies in normal pregnancy, pre-eclamptic toxaemia, renal clearance in health and disease and the effect of hospital care and parturition (with Dr. M. G. Kerr, Simpson Memorial Maternity Pavilion, Edinburgh).
19. Hormonal interrelationships during the normal menstrual cycle and in abnormal gynaecological conditions, especially anovular cycles, cystic glandular hyperplasia, endometrial carcinoma and the Stein-Leventhal syndrome (with Dr. D. V. I. Fairweather and Dr. D. G. Millar, Royal Victoria Infirmary, Newcastle upon Tyne, and Dr. D. Charles, Western Infirmary, Glasgow).
20. Effect of age and parity on hormone excretion in normal pregnancy (with Dr. D. V. I. Fairweather).
21. Effect of antiovulatory compounds on endocrine function in human subjects with special reference to the long-term effect of oral progestational agents.
22. Effect of gonadal stimulators, e.g. clomiphene (MRL-41), on endocrine function in infertile patients and in male subjects (with Dr. D. Charles, and with Dr. G. L. Foss, Bristol Royal Hospital).
23. Hormonal studies in placental insufficiency (with Dr. D. V. I. Fairweather and Dr. D. Charles, and with Dr. Jean Ginsburg, Charing Cross Hospital Medical School, London).
24. Relationship of gastroenterology to endocrinology, with special reference to:
    (*a*) Development of a radioimmunoassay for the gastrointestinal hormone gastrin.
    (*b*) Effect of hypophysectomy and hormone administration on the growth and parietal cell population of the stomach of rats.
    (*c*) Effect of hormones on gastric secretion in human subjects.
    (*d*) Hormone excretion in patients with liver disease and in patients with malabsorption.
25. Endocrinology of anorexia nervosa (with Dr. G. F. M. Russell, Maudsley Hospital, London).
26. Endocrinology of acne vulgaris (with Department of Dermatology, Royal Infirmary, Edinburgh).
27. Assessment of current methods of radioiodine therapy for thyrotoxicosis.
28. Studies on auto-immune disease with special reference to chronic thyroiditis, pernicious anaemia and adrenal insufficiency.

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ATHEROMA RESEARCH UNIT

Western Infirmary, Glasgow W.1
(Western 8822)

Director
B. Bronte-Stewart, M.D., M.R.C.P., M.R.C.P.G. (*died July 1965*)

Scientific staff

T. B. Begg, M.B., M.R.C.P., M.R.C.P.G.
C. J. W. Brooks, Ph.D. (*part-time*)
T. Fyfe, M.B.
Miss L. M. Hanaineh, B.Sc. (*until Oct. 1964*)
W. A. Harland, M.B., Ph.D., M.C.Path., F.R.C.P.Can.
J. W. Kerr, M.B., M.R.C.P., M.R.C.P.G.
B. R. Knowles, M.B., M.R.C.P.E. (*until Mar. 1964*)
W. D. Mitchell, A.H.-W.C.(Edin.), A.R.I.C.
Miss L. E. Murchison, M.B.
R. Pirrie, M.B., M.R.C.P.E. (*part-time*)
G. Steel, B.Sc.
A. S. Truswell, M.D., M.R.C.P. (*until Nov. 1964*)

Other senior staff
V. M. Wells, A.I.S.T.

The activities of this Unit are being directed towards the study of metabolic factors associated with ischaemic heart disease and other forms of occlusive vascular disease. The influence of such factors as the diet, physical exercise and other environmental variables will receive particular attention.

Summary of research

1. Gastrointestinal lipolytic activity in ischaemic heart disease.
2. Influence of bile acids on cholesterol and lipoprotein metabolism.
3. Abnormalities of serum lipid transport in atheroma.
4. Viscometry of blood and of related non-Newtonian fluids.
5. Interrelationships between platelet aggregation and chylomicrons, β-lipoproteins and other macromolecular substances.
6. Histamine metabolites in the urine and the metabolism of ^{14}C-histamine in allergic asthma.
7. Spectroscopic studies of molecular conformation and hydrogen bonding.
8. Applications of thin-layer and gas–liquid chromatography in biochemical analysis, with special reference to tissue lipids.

BODY TEMPERATURE RESEARCH UNIT

Department of the Regius Professor of Medicine, Radcliffe Infirmary, Oxford
(Oxford 49891)

Honorary Director
Professor Sir George Pickering, M.D., F.R.C.P., F.R.S.

Scientific staff

K. E. Cooper, M.B., M.Sc.
R. H. Johnson, M.B., D.Phil.
W. R. Keatinge, M.B., Ph.D.

Attached workers

A. T. Bevan, M.B., M.R.C.P. (*Radcliffe Infirmary*)
W. I. Cranston, M.D., M.R.C.P. (*Radcliffe Infirmary*)
P. A. Murphy, M.B., B.Sc., M.R.C.P. (*Radcliffe Infirmary*)
E. S. Snell, M.B., M.R.C.P. (*University of Oxford*)

The Unit is concerned with body temperature regulation, the means by which temperature regulation is altered during fever and the effects of body cooling in man.

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Summary of research

1. Site of action of bacterial and endogenous pyrogens.
2. Reaction between bacterial pyrogens and leucocytes.
3. Nature of endogenous pyrogens.
4. Location and mode of response of central temperature receptors.
5. Studies of patients with abnormalities of temperature regulation.
6. Mechanism of contraction of arterial smooth muscle.

OBSTETRIC MEDICINE RESEARCH UNIT*

University of Aberdeen Medical School, Foresterhill, Aberdeen
(Aberdeen 20381)

Honorary Director
Professor Sir Dugald Baird, M.D., D.Sc., F.R.C.O.G., D.P.H.

Honorary Deputy Director
A. M. Thomson, M.B., B.Sc., D.P.H.

Scientific staff

W. Z. Billewicz, M.Sc.
P. S. Brown, B.M., M.R.C.P.
K. J. Dennis, M.B., M.R.C.O.G.
Mrs. A. M. Finlayson, B.A. (*part-time; until Aug. 1964*)
G. W. Horobin, B.Sc.(Econ.)
F. E. Hytten, M.D., Ph.D.
R. Illsley, Ph.D.
J. C. Kincaid, B.Sc.
A. I. Klopper, M.B., Ph.D., F.R.C.O.G.
D. J. Oldman, B.A.

Other senior staff

G. A. Cheyne, F.I.M.L.T.
Miss A. R. Taggart, B.Sc.
Miss E. D. B. Thompson, B.A., Soc.Sci.Dip.
M. Wells, B.Sc.
G. R. Wilson

Attached workers

Miss J. Aitken-Swan (*MRC grant-holder*)
Miss A. Anderson, M.B., D.Obst.R.C.O.G. (*MRC grant-holder*)
W. R. Bytheway, B.Sc. (*Research Group in Biometric Medicine, University of Aberdeen*)
I. Cooke, M.B., M.R.C.O.G. (*University of Sydney*)
A. C. Turnbull, M.B., F.R.C.O.G. (*University of Aberdeen*)

The Unit collaborates with the Department of Midwifery and Gynaecology of the University of Aberdeen in research on the problems of maternity and family life and of gynaecology. There are two main divisions: (*a*) epidemiology and sociology, and (*b*) clinical physiology and endocrinology.

Summary of research

EPIDEMIOLOGICAL STUDIES

1. Causes of perinatal death.
2. Obstetrical implications of maternal height and weight and of gain in weight during pregnancy.
3. Anaemia and oedema during pregnancy.

* The Unit was disbanded in September 1965 on the retirement of Sir Dugald Baird. Two new research units have been set up to continue work in this field: the Medical Sociology Research Unit, under the honorary direction of Professor R. Illsley in the University Department of Sociology at Aberdeen, and the Reproduction and Growth Research Unit, under the direction of Dr. Angus Thomson at the Princess Mary Maternity Hospital, Newcastle upon Tyne.

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SOCIOLOGICAL STUDIES

1. Social and obstetrical background of physically and mentally handicapped children.
2. Educational attainment, intelligence and health of school children, with reference to their birth record and the social background (with support from and in collaboration with the Association for the Aid of Crippled Children).
3. Growth and mortality in children in a rural African village (in collaboration with the Council's laboratories in the Gambia).
4. Social mobility and migration, with special reference to their effects on vital statistics.
5. Social influences in the aetiology of carcinoma of the cervix.

CLINICAL PHYSIOLOGY AND ENDOCRINOLOGY

1. Changes in body composition during pregnancy and the puerperium.
2. Volume and composition of liquor amnii.
3. Blood volume and anaemia in pregnancy.
4. Physiology and excretion of the steroid sex hormones, and levels of excretion in normal and abnormal pregnancy.
5. Renal function during pregnancy and its endocrinological background.
6. Endocrinological aspects of gynaecological abnormalities and of abortion, including the effects of treatment with hormones.
7. Bioassay of gonadotrophins.

DENTAL RESEARCH UNIT

Dental School, Lower Maudlin Street, Bristol 1
(Bristol 20473)

Honorary Director

Professor A. I. Darling, D.D.Sc., M.D.S., M.R.C.S., F.D.S.R.C.S., F.F.D.R.C.S.I.

Scientific staff

R. J. Andlaw, M.S., L.D.S.R.C.S.
A. J. Gwinnett, B.D.S., L.D.S.R.C.S. (*until May 1964*)
N. W. Johnson, M.D.Sc., F.D.S.R.C.S. (Eng.)
D. F. G. Poole, Ph.D.
L. M. Silverstone, B.Ch.D., L.D.S., L.D.S.R.C.S.
M. V. Stack, Ph.D.

The Unit is principally concerned with the pathology of dental caries. Present work aims at determining the histological, chemical and physical properties of normal enamel, and the changes occurring in these properties as caries develops.

Summary of research

HISTOLOGICAL STUDIES

1. Significance of the variability of ' normal ' enamel structure, determined by polarized light and phase-contrast microscopy and by microradiography, in the understanding of the structural changes of enamel during the earliest stages of caries.
2. Relationship between the structure and arrangement of the components of enamel, e.g. the packing of crystallites, and the penetration of enamel by various ions and molecules.
3. Comparison between the changes in enamel structure induced artificially with acids and chelating agents and the changes occurring in natural caries.
4. Electron microscope studies of oral tissues.

CHEMICAL STUDIES

1. Characterization of enamel proteins by pyrolysis and gas chromatography.
2. Separation and identification of acids produced by mixtures of saliva and various foodstuffs using thin-layer chromatography, gas chromatography and electrophoresis.
3. Nature of the cariostatic effects of certain ions such as fluoride and various phosphates.

PHYSICAL STUDIES

1. Crystal properties of enamel.
2. Pore structure of enamel and dentine studied by sorption techniques.

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1. Relationship between age and dimensions of developing deciduous teeth, and the effects on growth of certain pathological factors.
2. Dental characteristics and tooth replacement patterns in lower vertebrates (with Dr. J. S. Cooper, Department of Dental Surgery, Bristol).

TUBERCULOSIS AND CHEST DISEASES RESEARCH UNIT

Medical Research Council Laboratories, Holly Hill, London N.W.3
(Hampstead 2232)

Director

Wallace Fox, M.D., F.R.C.P.*
P. M. D'Arcy Hart, C.B.E., M.D., F.R.C.P. (*until June 1965*)

Scientific staff

Miss J. F. Heffernan, M.B., D.P.H.
D. M. Macfadyen, M.B., M.R.C.P.†
A. B. Miller, M.B., M.R.C.P.
Miss Christine Miller (Mrs. Manning), B.M. (*part-time*)
D. N. Mitchell, M.D.
Miss R. Tall, B.Sc.

The Unit is adjusting its work to meet the present pattern of tuberculosis—in decline in Britain but still a very serious and continuing problem in many developing countries. Statistically controlled clinical trials of the value of different chemotherapeutic agents and methods have been undertaken in Britain and overseas (notably in India and East Africa, where the Council has scientific responsibility for the trials), and associated problems (e.g. drug resistance) have been studied. The national trial of the value of measures of specific immunization in tuberculosis continues. The investigations of the Unit have been extended to certain methods of treatment of thoracic carcinoma, to the epidemiology of non-tuberculous mycobacterial infections in Britain, and to the aetiology of sarcoidosis. The Unit co-operates actively with the Council's Statistical Research Unit and the Unit for Research on Drug Sensitivity in Tuberculosis.

Summary of research

1. Chemotherapy in tuberculosis:
   (*a*) Chemotherapy of pulmonary tuberculosis with pneumoconiosis (in collaboration with the Miners' Chest Diseases Treatment Centre, South Wales).
   (*b*) Chemotherapy of tuberculosis practicable in East Africa:
      (i) the use of thiacetazone with isoniazid;
      (ii) the use of these two drugs intensified by adding streptomycin initially;
      (iii) the value of two levels of intensity of home-visiting in out-patient supervision.
   (*c*) Possible side-effects from thiacetazone with isoniazid in various racial communities.
   (*d*) Treatment of pulmonary tuberculosis in South India (in collaboration with the World Health Organization, the Indian Council of Medical Research and the Madras State Government at the Tuberculosis Chemotherapy Centre, Madras), in particular:
      (i) effectiveness and practicability of supervised intermittent chemotherapy;
      (ii) the use of thiacetazone with isoniazid;
      (iii) metabolism of several antituberculous drugs.
   (*e*) The use of thiacetazone with streptomycin in Rhodesia.
2. Prevalence of drug resistance in tuberculosis:
   (*a*) Primary resistance in Britain (for comparison with the 1955–56 MRC survey).
   (*b*) Resistance in patients applying for treatment in Hong Kong chest clinics.
   (*c*) Resistance in newly diagnosed cases in East Africa.
3. Protection afforded by BCG and vole bacillus vaccines in adolescence and early adult life in Britain.

* Dr. Fox, already a member of the staff of the Unit, succeeded Dr. D'Arcy Hart as Director on the latter's retirement in July 1965.
† Working in Nairobi.

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4. Specificity of the tuberculin reaction in Britain; epidemiology of sensitivity to avian and human tuberculins.
5. Comparisons of treatment of certain types of carcinoma of the bronchus by surgery, by radiotherapy and by cytotoxic drugs.
6. Aetiology of sarcoidosis in young adults; mechanism of the Kveim skin test.
7. Methodology of controlled clinical trials.

UNIT FOR RESEARCH ON DRUG SENSITIVITY IN TUBERCULOSIS

Postgraduate Medical School of London, Ducane Road, London W.12
(Shepherds Bush 2030)

Honorary Director
D. A. Mitchison, M.B.

Scientific staff
Mrs. A. Csillag-Szekely, Ph.D.
Miss J. M. Dickinson, L.R.C.P.I. & S.I.
G. A. Ellard, Ph.D.
M. J. Lefford, M.B.

Other senior staff
J. K. Clancey*
E. A. Edwards*

The Unit studies the bacteriological aspects of mycobacterial infections in man. Particular attention is given to bacteriological methods in the chemotherapy and epidemiology of tuberculosis and to the classification of mycobacteria. The Unit works in close association with the Council's Tuberculosis and Chest Diseases Research Unit and Statistical Research Unit.

Summary of research

1. Provision of centralized bacteriological services for:
   (*a*) Trial of long-term chemotherapy in the control of pulmonary tuberculosis with pneumoconiosis.
   (*b*) Trials of new methods of chemotherapy in East Africa.
   (*c*) International trial of chemotherapy regimens for pulmonary tuberculosis in 21 countries (in co-operation with the International Union against Tuberculosis).
   (*d*) National survey of the prevalence of drug resistance in tubercle bacilli from newly diagnosed patients with pulmonary tuberculosis.
2. Participation with the World Health Organization, the Indian Council of Medical Research and the Madras State Government in the work of the Tuberculosis Chemotherapy Centre, Madras :
   (*a*) Estimation of the virulence in guinea pigs of strains of tubercle bacilli isolated from patients in clinical trials.
   (*b*) Estimation of the frequency with which patients and their contacts are infected with the same strains of tubercle bacilli.
3. Survey of the geographical distribution of attenuated tubercle bacilli in several countries in the Middle and Far East (in collaboration with the World Health Organization).
4. *In vitro* and animal experiments on intermittent chemotherapy for tuberculosis.
5. Comparison of several sensitivity test methods.
6. Classification and life cycle of mycobacteria.

* Working on the East African Tuberculosis Chemotherapy Trial (Mr. Clancey in Kenya and Mr. Edwards in Uganda).

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UNIT FOR RESEARCH ON THE EXPERIMENTAL PATHOLOGY OF THE SKIN

The Medical School, The University, Birmingham 15
(Selly Oak 2103)

Director
C. N. D. Cruickshank, M.D., M.C.Path., D.I.H.

Scientific staff

M. Baxter, M.Sc.
A. O. T. Charles, Ph.D.
E. A. Fairburn, M.D., M.R.C.P. (*honorary*)
Professor P. G. H. Gell, M.B. (*honorary*)
K. R. Haye, M.B.
Mrs. E. A. Hell, D.Phil.
G. I. Horsfield, M.B.
B. C. Tate, M.B.E., M.D., F.R.C.P. (*honorary*)
M. D. Trotter, Ph.D.
Mrs. T. Webb, Ph.D.
H. J. Yardley, Ph.D.

Other senior staff
J. R. Cooper, F.I.M.L.T.

Attached workers

J. F. Kennedy, M.Sc. (*MRC Scholar*)
Miss D. M. Rimmer (*MRC Scholar*)
R. Summerly, M.B., M.R.C.P. (*MRC Clinical Research Fellow*)

The aim of the Unit is to achieve a better understanding of the structure and functions of the skin in health and disease. Considerable emphasis has been placed upon the study of metabolic processes *in vitro* and upon a study of allergy.

Summary of research

1. Metabolic pathways in skin (studied by various methods, including the use of radioactive isotopes), particularly the fatty acid and cholesterol metabolism of skin.
2. The effects of hormonal, chemical and physical agents on the metabolism and cytology of skin *in vitro*.
3. Effects of hormones and vitamin A on the synthesis of mucopolysaccharides of the dermis and epidermis.
4. The cytology of normal and abnormal skin in tissue culture, including the behaviour of pigmented and non-pigmented dendritic cells as revealed by time-lapse cine-micrography.
5. Chemical structure of the allergenic glycopeptides of the dermatophytic fungi, their cross-reactions, and the effects of modifying their chemical structure on the ' immediate ' and ' delayed ' reactions.
6. The mechanism of delayed hypersensitivity in guinea pigs: studies on delayed reactions to simple chemical groups attached to homologous (guinea pig) albumin with special reference to the specificity of their cross-reactions with related compounds.
7. Role of the basophil and mast cell in allergic and other tissue reactions.
8. Mechanism of keratin digestion by dermatophytic fungi.
9. Factors initiating regeneration of epithelium after skin injury; comparison of epidermal cell replacement in normal and psoriatic skin.
10. Trace metals and enzymes in the sera of patients with skin disease.
11. Investigation of materials suspected of causing industrial skin disease.

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MINERAL METABOLISM RESEARCH UNIT* 121

The General Infirmary, Great George Street, Leeds 1
(Leeds 32799)

Director
B. E. C. Nordin, M.D., Ph.D., M.R.C.P.

Assistant Director
A. Hodgkinson, Ph.D., F.R.I.C.

Scientific staff

N. A. Edwards, B.Sc.
F. W. Heaton, Ph.D., A.R.I.C.
Mrs. B. A. Heppell, B.Sc. (*until Dec. 1963*)
D. J. Lea, Ph.D.
L. Martindale, B.Sc. (*until Feb. 1965*)
C. B. Oxby, B.Sc.
M. Peacock, M.B.
W. G. Robertson, B.Sc.
R. G. G. Russell, B.A.
Miss I. Susanson, M.B.

Other senior staff
P. M. Zarembski, F.I.M.L.T.

The Unit is concerned with the study of renal lithiasis and disturbances of bone metabolism.

Summary of research

1. Renal lithiasis:
   (*a*) Ionic products of calcium phosphate and calcium oxalate in urine of normal subjects and patients with renal calculus.
   (*b*) Assay of parathyroid hormone and diagnosis of primary hyperparathyroidism.
   (*c*) Epidemiology of renal lithiasis.
2. Bone metabolism:
   (*a*) Spinal X-ray densitometry.
   (*b*) Metabolic studies of bone in tissue culture.
3. Radioisotopes:
   Intestinal absorption of calcium and strontium.

DEMYELINATING DISEASES RESEARCH UNIT†

13 Framlington Place, Newcastle upon Tyne 2
(Newcastle 25131)

Honorary Director
E. J. Field, M.D., M.S., Ph.D., M.R.C.P.

Honorary Clinical Adviser
Professor H. G. Miller, M.D., F.R.C.P., D.P.M.

Scientific staff

E. A. Caspary, M.Sc.
V. R. Cunningham, Ph.D. (*until Sept. 1964*)

Other senior staff
D. Hughes, B.Sc.

The Unit has continued to investigate the biological properties and significance of EF (encephalitogenic factor isolated from human brain) in the pathogenesis of experimental allergic encephalomyelitis and disseminated (or multiple) sclerosis. The action of EF in promoting stickiness of the blood cells has been investigated in neurological diseases, and stickiness of platelets, which EF enhances in cases of disseminated sclerosis, is also being studied. Pathogenicity of disseminated sclerosis brain material for various animals is under study in an attempt to confirm the previous finding of the development of scrapie (or a scrapie-like disease) in sheep inoculated with acute MS brain.

* The Unit, established in 1957 as the Metabolic Distrubances in Surgery Research Unit, was renamed in September 1964 when Dr. Nordin succeeded Professor Pyrah as Director.

† This establishment was first set up in 1961 as a Group but reconstituted as a Unit in April 1965.

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Summary of research

1. Toxicity of disseminated sclerosis serum for central and peripheral myelinated nerve fibres in tissue culture and for glial cells.
2. Pathogenicity for animals (especially sheep, goats, mice) of nervous tissue from acute cases of multiple sclerosis.
3. Electron microscope study of degenerative change in the central nervous system: scrapie in the mouse, triorthocresyl phosphate poisoning in chickens and wabbler-lethal (genetically determined) demyelination.
4. Biological activity of EF.
5. Lactic dehydrogenase isoenzymes in body fluids in disseminated sclerosis.
6. Analysis of data from an extended survey of disseminated sclerosis in north eastern England, with special reference to familial occurrence and the role of pregnancy in the natural history of the disease.
7. Clinical therapeutic trials in disseminated sclerosis: control trial of hydroxocobalamin; pilot trials of BAL and Rheomacrodex.
8. Blood group distribution in a large sample of disseminated sclerosis patients.

EXPERIMENTAL HAEMATOLOGY RESEARCH UNIT

Wright-Fleming Institute of Microbiology, St. Mary's Hospital Medical School, London W.2

(Paddington 1662)

Director

Professor P. L. Mollison, M.D., F.R.C.P., F.C.Path (*part-time*)

Scientific staff

M. C. Adinolfi, M.D.
S. Ardeman, B.M.
P. Barkhan, M.D., Ph.D., M.C.Path. (*honorary*)
I. Chanarin, M.D., B.Sc., D.C.P., M.C.Path. (*honorary*)
Miss P. E. Crome, M.B. (*until Mar. 1964*)
N. C. Hughes Jones, B.M., Ph.D.
Miss A. McLean, Ph.D.
Miss M. J. Polley, Ph.D.*

Visiting workers

Miss J. Economidou, M.D. (*University of Athens, State Scholarships Foundation of Greece*)
Miss E. Rochna Viola, M.D. (*Comision Nacional de Energia Atomica, Buenos Aires*)
J. A. Winkelstein (*Albert Einstein College of Medicine, New York*)

The Unit's aim is to link experimental and clinical studies in the field of haematology.

Summary of research

1. Kinetics of antigen–antibody reactions.
2. Determination of the number of group A antigen sites on red cells.
3. Analysis of H and L peptide chains in blood group antibodies.
4. Non-specific binding of complement by red cells in medium of low ionic strength.
5. Characterization of blood group antibodies in terms of immunoglobulins.
6. Automation of blood grouping.
7. Relation between amount of antibody on red cells and rate of clearance from the circulation.
8. Estimation of amount of antibody on red cells in haemolytic disease of the newborn.
9. Standardization of anti-human-globulin sera.
10. The blood group antibody anti-I in the newborn.
11. Characterization of the factor in normal serum causing lysis of red cells in patients with paroxysmal nocturnal haemoglobinuria.
12. Development of a method for assaying human intrinsic factor in gastric juice.
13. Physiology and pathology of intrinsic factor secretion.
14. Folic acid metabolism in megaloblastic anaemia.
15. Platelet survival in various disorders of haemostasis.
16. Clinical, haematological and biochemical investigations of abnormal haemoglobins.

* On leave of absence, working in the Division of Experimental Pathology, Scripps Clinic and Research Foundation, La Jolla, California.

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BLOOD GROUP RESEARCH UNIT 123

Lister Institute, Chelsea Bridge Road, London S.W.1
(Sloane 4042)

Director
R. R. Race, Ph.D., F.R.C.P., F.R.S.

Scientific staff
Miss E. J. Gavin, B.Sc.
J. F. Moloney, B.Sc. (*until Dec. 1963*)
Miss J. E. Noades, B.Sc.
Miss R. A. Sanger, Ph.D.
Miss P. A. Tippett, Ph.D.

The Unit is searching for unrecognized blood group antigens and studying the inheritance of those already known. Information about the antigens is being applied to the cartography of the human chromosomes and to the investigation of chromosomal abnormalities. The antigens are also involved in problems of haemolytic disease of the newborn and adverse reaction to transfusion. All the investigations listed below except the first have been carried out in collaboration with numerous colleagues in this country and abroad.

Summary of research

1. The X-linked blood group system Xg.
2. The use of Xg in the investigation of abnormalities of form or of number of the sex chromosomes.
3. The use of Xg in the mapping of genes on the X chromosome.
4. Xg in anthropoid apes.
5. Blood groups and abnormalities of the autosomes.
6. Blood groups and problems of twinning, chimerism, mosaicism and dispermy.
7. Identification of an antigen, Do^a, which defines a new blood group system.
8. Rh system: the ' D-like ' antigen LW; the presence of anti-D in D-positive people.
9. P system: the antigens P^k and ' Luke '.
10. Examination of sera suspected of containing new blood group antibodies.

BLOOD GROUP REFERENCE LABORATORY

(*Administered by the Council for the Ministry of Health*)

Gatliff Road, off Ebury Bridge Road, London S.W.1
(Sloane 2152)

Director
K. L. G. Goldsmith, M.B., Ph.D., M.C.Path.*
A. E. Mourant, D.M., D.Phil., F.R.C.P., F.C.Path.

Scientific Staff
Miss C. M. Giles, B.Sc.
Miss E. W. Ikin, Ph.D.
Mrs. H. D. Nunn, B.Sc.

Visiting worker
R. Narayanan, M.B. (*Safdarjang Hospital, New Delhi*)

* Dr. Goldsmith succeeded Dr. Mourant as director of the Laboratory in September 1965 when the latter transferred to the Council's external scientific staff for work at the Serological Population Genetics Laboratory at St. Bartholomew's Hospital, London.

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The Laboratory is responsible for large-scale processing of blood grouping serum of human origin and for issuing it to the National Blood Transfusion Service, the Armed Forces, and hospitals in the United Kingdom and overseas, and for the production of animal sera both for routine issue and for experimental purposes. Technical and clinical advice and instruction are given to visiting workers, both individually and by means of organized courses, and general assistance over a wide field is given to a large number of laboratories, transfusion centres and research institutes. The Laboratory is continuing to carry out comparative trials of new techniques, to develop lines of research arising from cases of clinical and scientific interest referred for investigation, and to co-operate with scientific and clinical colleagues in the study of immunological problems arising from transplant surgery.

Summary of activities

1. Large-scale production and issue of blood grouping sera of both human and animal origin, including work on the preparation of International Standards.
2. Experimental production of blood grouping sera in animals.
3. Experimental production, preparation and standardization of anti-human-globulin sera of various specificities (in collaboration with the Council's Blood Transfusion Committee).
4. The provision of reference facilities, including full red cell grouping of laboratory and hospital staffs for use as control panels, and the investigation of human and animal sera submitted by laboratories for checking prior to their use as grouping sera.
5. ABO and Rh grouping of all recruits to the London Red Cross Blood Transfusion Service.
6. Full red cell grouping of donors for the National Panel of Blood Donors, maintenance of Panel records, and periodic issue of revised Panel lists.
7. Investigation of cases referred to the Laboratory for clinical or scientific reasons, including the determination of red cell and serum groups and the specificity of red cell, leucocyte and platelet antibodies.
8. Follow-up research arising from cases referred, including family studies, and the investigation of ' new ' blood group antigens and antibodies.
9. Development of immunological methods for selecting donors and recipients of organ and tissue grafts, and of reliable *in vivo* and *in vitro* compatibility tests, examination of pre- and post-graft sera, and follow-up of patients.
10. Investigation of red cell antigens in blood stored in liquid nitrogen.
11. Plant haemagglutinins.
12. Participation in anthropological surveys.
13. Possible associations between blood groups and disease (in collaboration with clinicians).

BLOOD COAGULATION RESEARCH UNIT

Churchill Hospital, Oxford
(Oxford 64841)

Director

Professor R. G. Macfarlane, C.B.E., M.D., F.R.C.P., F.R.S. (*part-time*)

Scientific staff

Mrs. E. Bidwell, Ph.D., F.R.I.C.
Miss R. Biggs, M.D., Ph.D.
R. H. Gandy, M.B. (*part-time; until Feb. 1965*)
S. Goldenberg, M.B. (*part-time*)
F. Ilahi, M.B. (*part-time; until Dec. 1964*)

Other senior staff

K. W. E. Denson, F.I.M.L.T.
G. W. R. Dike

Visiting workers

C. Hougie, M.D. (*American Heart Association*)
F. Jobin, M.D. (*Canadian Rhodes Scholar*)
J. M. Matthews, M.B. (*MRC Clinical Research Fellow*)
Mrs. J. Matthews, M.R.C.V.S. (*Animal Health Trust Research Training Scholar*)
N. N. Sen, M.D., D.C.P., M.C.Path. (*Colombo Plan Fellow*)
Mrs. R. Sen, M.B. (*Institute of Child Health, Calcutta*)

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The Unit is studying the mechanism of normal coagulation and any abnormalities which may cause excessive haemorrhage or thrombosis. The object of this work is to gain knowledge which may assist in preventing the occurrence of these abnormalities and to improve the methods of treatment of patients in whom they have already occurred.

Summary of research

1. Investigation, diagnosis and treatment of cases of abnormal bleeding due to deficiency of clotting factors or the presence of anticoagulants, and study of their aetiology, including congenital factors.
2. Production of concentrated Christmas factor in collaboration with the Blood Products Laboratory of the Lister Institute, Elstree, Herts., and its application in the treatment of Christmas disease.
3. Attempts to reduce or remove the antigenic properties of antihaemophilic globulin derived from animal blood.
4. Purification of blood clotting factors (with Mr. J. R. P. O'Brien and Dr. M. P. Esnouf, Biochemical Department, Radcliffe Infirmary, Oxford).
5. Mechanisms of the interaction of blood clotting factors and the nature of their activity.
6. Structure of thrombi as they occur *in vivo* and the factors which favour or oppose their formation (with Dr. J. E. French and Dr. A. G. Sanders of the Sir William Dunn School of Pathology, Oxford).
7. Standardization of methods and reagents used for the routine assay of clotting factors.
8. Blood level of clotting factors and their natural inhibitors in the normal population and in cases of thrombosis.

ABNORMAL HAEMOGLOBIN RESEARCH UNIT

University Department of Biochemistry,
Tennis Court Road, Cambridge
(Cambridge 51781)

Honorary Director
H. Lehmann, M.D., Sc.D., F.R.C.P., F.R.I.C., F.C.Path.

Scientific staff
D. Beale, B.Sc.
Miss D. A. Davies, Ph.D.

Other senior staff
D. Irvine

Visiting workers
Mrs. J. Gröbler, D.Phil. (*National Blood Transfusion Laboratory, Budapest*)
H. R. Marti, Privat Dozent Dr.Med. (*Basel University grant-holder*)

This Unit investigates the chemical nature of abnormal haemoglobins and variants of serum proteins and enzymes, which are collected from all parts of the world.

Summary of research

1. Identification of three new abnormal haemoglobin variants, Hb D Ibadan, Hb J Oxford and Hb G Accra; partial investigation of other abnormal haemoglobins in man and animals.
2. Surveys for haemoglobin variants and other inherited characters of population samples from Afghanistan, Pakistan, Iran and Venezuela.
3. Reference work on abnormal haemoglobins for laboratories in the United Kingdom and overseas.
4. Chemical properties of human pseudocholinesterase variants and of animal cholinesterases.

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CELLULAR IMMUNOLOGY RESEARCH UNIT

Sir William Dunn School of Pathology, University of Oxford
(Oxford 57321)

Honorary Director
Professor J. L. Gowans, M.B., D.Phil., F.R.S.

Attached workers

W. L. Ford, M.B. (*Beit Memorial Fellow*)
P. J. McCullagh, M.B. (*Rhodes Scholar*)
S. Strober, B.A. (*Harvard University Medical School*)
I. L. Weissman, M.D. (*Stanford University Medical School*)

This Unit, which was established in October 1963, is concerned with the physiological and immunological functions of lymphoid tissue.

Summary of research

1. Immunological responses of the isolated perfused spleen.
2. Macrophage–lymphocyte interactions in antibody formation.
3. Mechanism of sensitization to renal homografts.
4. Output of cells from the thymus in animals of various ages.
5. Activities of small lymphocytes from immunized and tolerant animals.

CLINICAL PULMONARY PHYSIOLOGY RESEARCH UNIT*

King's College Hospital Medical School, Denmark Hill, London S.E.5
(Brixton 6222)

Director
P. Hugh-Jones, M.D., F.R.C.P. (*part-time*)

Scientific staff

Mrs. M. W. McGrath, Ph.D. (*until Dec. 1963*)
N. B. Pride, M.B., M.R.C.P.

Visiting and attached workers

M. J. Grayson, M.B., M.R.C.P. (*King's College Hospital*)
J. Jordanoglou, M.D. (*Evangelismos Hospital, Athens*)
P. Keelan, M.D., M.R.C.P., M.R.C.P.I. (*Council of Europe Medical Fellow*)
B. C. Ritchie, M.B., M.R.A.C.P. (*Nuffield Foundation Fellow*)
A. R. Tanser, M.B., M.R.C.P. (*King's College Hospital*)

The Unit is studying the effects of disease in the human lung using, among other methods, new techniques that show the distribution of air and blood to each of the different pulmonary lobes. These methods can be used to assess the indications for medical or surgical treatment and their results.

Summary of research

1. Regional distribution of gas and blood in normal lungs and the changes in this caused by disease:
   (*a*) Topographical distribution, by the use of radioactive gases, without intubation of patients (in collaboration with the staff of the Cyclotron Unit and Postgraduate Medical School).
   (*b*) Distribution in individual lobes and segments, studied with a mass spectrometer sampling system and flow-meter during routine diagnostic bronchoscopy.

* The Unit, which was established in January 1964, is continuing the work carried out since 1956 at the Postgraduate Medical School, Hammersmith Hospital, under Dr. Hugh-Jones's part-time direction.

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2. General and regional lung function in chronically breathless patients, at rest and during exercise, as a basis for definition of different clinical conditions; the indications for surgery when localized emphysema is found.
3. Effects of some heart abnormalities on the lungs (in collaboration with the Cardiac Department of King's College Hospital).

VISION RESEARCH UNIT

Institute of Ophthalmology, Judd Street, London W.C.1
(Euston 9621)

Director
H. J. A. Dartnall, D.Sc., F.R.I.C.

Scientific staff

C. D. B. Bridges, Ph.D.
J. N. Lythgoe, Ph.D.
J. D. Moreland, Ph.D.
Mrs. P. H. Silver, Ph.D.

The Unit is concerned with the pigmentary, photochemical and photoreceptoral bases of vision in man and animals, and with all matters affecting the qualities of light incident on retinas. The visual pigments are studied both after extraction into solution and also in their native photoreceptor environment. Observations on the pigments in action are provided by cognate work on the visual characteristics of the relevant animals, including man. There are three main objectives in these studies: (*a*) to explore the distribution of visual pigments and to correlate the findings with taxonomy and environmental demands; (*b*) to elucidate the structures and chemical reactions of the visual pigments, and (*c*) to measure and interpret visual characteristics.

Summary of research

1. Visual pigments in vertebrates, and correlation with light environment (arrangements have been made in various parts of the world for specimens of retinas and eyes to be sent for examination, and a limited amount of field work is carried out by means of skin diving techniques to obtain fishes from known depths in the seas).
2. Effects of changing environment, e.g. influence of day length, light intensity and quality and water salinity on visual pigments in migratory and non-migratory fishes.
3. Visual pigments in rod and cone preparations.
4. Measurement of visual sensitivities with automatic apparatus.
5. Measurement of lens and corneal pigmentation.
6. Purkinje's blue arcs.
7. Relationship between the fine structure of photoreceptor outer segments and photochemical data.
8. Effect of drugs on colour vision in humans.
9. Human peripheral colour vision.

TRACHOMA RESEARCH UNIT

Lister Institute of
Preventive Medicine,
Chelsea Bridge Road,
London S.W.1
(Sloane 2181)

Medical Research
Council Laboratories,
Fajara,
Bathurst,
Gambia

Honorary Director
L. H. Collier, M.D.

Scientific staff

W. A. Blyth, Ph.D.
Miss D. M. Graham, M.Sc.
Mrs. E. F. Hart, B.Sc.
P. Reeve, Ph.D.
J. Sowa, M.Sc. (*Gambia*)
Mrs. S. C. I. Sowa, M.B., D.O. (*Gambia*)
Mrs. J. Taverne, Ph.D.

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Attached worker

Miss G. Sampson, B.Sc. (*Lister Institute, Elstree*)

At the Lister Institute, research is directed to the production and assay of experimental trachoma vaccines, the replication and serological reactions of trachoma and related micro-organisms, and experimental infections in man and the baboon.

In the Gambia, attention is mainly concentrated on field trials of trachoma vaccines, on the early stages of the disease in babies, and on genital tract infections of adults with trachoma/inclusion blennorrhoea agents.

Summary of research

1. Trachoma and inclusion blennorrhoea agents:
   (*a*) Growth in chick embryos and cell cultures.
   (*b*) Serological reactions and antigenic relationships.
   (*c*) Experimental infections in man and animals.
   (*d*) Methods of purification and preservation.
2. Trachoma vaccine:
   (*a*) Methods of production and assay.
   (*b*) Field trials.
3. Field studies of trachoma:
   (*a*) Clinical aspects.
   (*b*) Epidemiology.
   (*c*) Microbiology.
   (*d*) Relation between trachoma and inclusion blennorrhoea, with special reference to genital tract infection of adults and infection in the neonatal period.

WERNHER RESEARCH UNIT ON OPHTHALMOLOGICAL GENETICS*

Royal College of Surgeons of England, Lincoln's Inn Fields, London W.C.2

(Holborn 3474)

Honorary Director

Professor Arnold Sorsby, M.D., F.R.C.S.

Scientific staff

J. P. Newhouse, B.Sc.

H. W. Reading, Ph.D.

Attached workers

G. R. Fraser, M.B., Ph.D. (*Godfrey Robinson Unit, Royal College of Surgeons*)

G. A. Leary, F.S.M.C. (*Royal Eye Hospital, London*)

A. I. Friedmann, M.B., F.R.C.S. (*Godfrey Robinson Unit, Royal College of Surgeons*)

The Unit is studying the genetic aspects of ophthalmology, particular attention being paid to retinal dystrophy and the components of ocular refraction.

Summary of research

1. Inherited retinal dystrophy in the rat: studies on metaboiism with particular reference to enzyme systems and protein synthesis.
2. Experimental degeneration of the retina in the rabbit with particular reference to the significance of the role of –SH radicles and protein structure.

* Financed from Alexander Pigott Wernher Memorial Trust funds.

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3. Clinical studies:
   (*a*) Classification of the causes of blindness found in schools for the blind.
   (*b*) Chromatography studies on the urine of children with genetically determined affections.
4. The refraction of the eye:
   (*a*) The components of ocular refraction in man, and their genetic behaviour in human families.
   (*b*) The scope of ultrasonography in the clinical measurement of the ocular components.

OTOLOGICAL RESEARCH UNIT

National Hospital for Nervous Diseases,
Queen Square, London W.C.1
(Terminus 3611)

Director
C. S. Hallpike, C.B.E., M.B., F.R.C.P., F.R.C.S., F.R.S.

Scientific staff
S. K. Bosher, F.R.C.S.
Miss M. R. Dix, M.D., F.R.C.S.
J. D. Hood, D.Sc., F.Inst.P.

Other senior staff
E. Trinder, A.M.I.E.E.

The work of the Unit is devoted to clinical and laboratory studies of the ear and the VIII nerve system in man, including its anatomy, physiology and pathology and the clinical manifestations of disease. New methods and equipment are being developed for clinical and laboratory investigation of the auditory and vestibular apparatus.

Summary of research

1. Clinico-pathological investigations, including histological examination of the temporal bones and central nervous pathways in vertigo, deafness and other organic derangements of cochlear and vestibular function.
2. Clinical, anatomical and electro-acoustic investigations of the loudness recruitment phenomenon and other aspects of cochlear function in health and disease of the VIII nerve system.
3. Physiological studies of the semicircular canal system in man.
4. Experimental studies on the physiology and pathology of vertigo.
5. Biochemical studies of the labyrinthine fluids.

WERNHER RESEARCH UNIT ON DEAFNESS*

King's College Hospital Medical School,
Denmark Hill, London S.E.5
(Brixton 4744)

Director
T. S. Littler, Ph.D., F.Inst.P.

Honorary Clinical Director
Sir Terence Cawthorne, F.R.C.S.

Scientific staff
J. J. Knight, Ph.D., A.Inst.P. (*until Sept. 1964*)
C. G. Rice, B.Sc. (*until Dec. 1963*)
M. Wipat, M.B., B.Sc., D.L.O., F.R.C.S.E. (*until Sept. 1964*)

* The work of this unit is financed from Alexander Pigott Wernher Memorial Trust funds, with the exception of the audiometric surveys, the cost of which is borne by the Ministry of Pensions and National Insurance.

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Attached worker

Surg. Cdr. R. R. A. Coles, M.B., D.L.O., R.N.

The Unit was established by the Alexander Pigott Wernher Memorial Trustees, to investigate medical and physical aspects of deafness. It collaborates with the Post Office Research Station and the Ministry of Health in research on the development of hearing aid and audiometry equipment, and is associated with the Ear, Nose and Throat Department of King's College Hospital in clinical investigations.

Summary of research

1. Testing of hearing by bone conduction as a diagnostic procedure and the standardization of bone conduction audiometry.
2. Improvement in hearing aid equipment including the use of binaural hearing devices.
3. Special hearing aid requirements of children in schools for the deaf (in collaboration with London County Council).
4. Speech audiometry in children and adults.
5. Continuous recording threshold audiometry.
6. Audiometric surveys in industrial situations and hearing-conservation programmes (in collaboration with the National Physical Laboratory).

RADIOBIOLOGICAL RESEARCH UNIT

Harwell, Nr. Didcot, Berks.

(Rowstock 393)

Director

J. F. Loutit, C.B.E., D.M., F.R.C.P., F.R.S.

Deputy Director

R. H. Mole, B.M., F.R.C.P., M.C.Path (*until Dec. 1964*)
G. E. Harrison, D.Sc., F.Inst.P. (*from April 1965*)

DIRECTOR'S GROUP

Scientific staff

M. J. Ashwood Smith, Ph.D.
D. W. H. Barnes, B.M., F.C.Path.
H. S. Micklem, D.Phil.*
D. G. Papworth, B.Sc.
L. A. Stocken, D.Phil, F.R.I.C. (*honorarium*)

Other senior staff

E. J. Lucas, M.B.E.

BIOCHEMISTRY

Scientific staff

J. St. L. Philpot, M.A. (*Head of group*)
J. H. Barnes, M.Sc., A.R.I.C.†
G. W. Bazill, B.Sc.
A. P. J. Phillips, B.Sc.
Miss J. E. Stanier, D.Phil. (*until June 1964*)

Other senior staff

J. V. Horgan
D. A. Stock

BIOPHYSICS

Scientific staff

G. J. Neary, Sc.D. (*Head of group*)
A. L. Batchelor, Ph.D.
B. A. Bridges, Ph.D.
H. J. Evans, Ph.D.
R. J. Munson, Ph.D.
R. J. Preston, B.A.
D. M. Robinson, Ph.D.
J. R. K. Savage, Ph.D.
D. Scott, B.Sc.

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* On leave of absence at Institut Pasteur, Paris.

† Seconded to International Atomic Energy Authority as Adviser to Government of Philippines from December 1963 to June 1964.

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Other senior staff

D. A. Bance
M. J. Corp, M.S.R.
P. Gray
D. A. Martin
W. S. G. Weal
C. F. Wright, F.I.S.T.

CYTOGENETICS

Scientific staff

C. E. Ford, D.Sc., F.R.S. (*Head of group*)
E. P. Evans, Ph.D.
Mrs. J. Gray, B.Sc.
J. Kahn, Ph.D. (*until June 1964*)
D. A. Ogden, B.Sc.

Other senior staff

G. Breckon

GENETICS

Scientific staff

Miss M. F. Lyon, Ph.D. (*Head of group*)
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EXPERIMENTAL PATHOLOGY

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PHYSIOLOGY

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Other senior staff

W. R. Lush

RADIOCHEMISTRY

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Mrs. A. Harrison, Ph.C.
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B. J. Parsons, Ph.D.

Other senior staff

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Mrs. J. A. Hancox (*until Mar. 1964*)
G. R. Howells
K. J. Kapota

ADMINISTRATIVE STAFF

F. D. Bushell (*Administrator*)
L. C. G. Manwaring, A.L.A. (*Librarian*)

VISITING AND ATTACHED WORKERS

B. M. Cattanach, Ph.D. (*MRC Mutagenesis Research Unit, Edinburgh*)
Captain A. W. Horne, B.V.Sc., M.R.C.V.S., R.A.V.C. (*Ministry of Defence*)
Mrs. K. Kostial-Zivanovic-Simonovic, M.D. (*Institute of Medical Research, Yugoslavia*)
L. E. Lagneau, M.D. (*Centre de Tumeurs de l'Université Libre de Bruxelles*)
Mrs. Alena E. Pogossaints, D.Biol.Sc. (*Institute of Experimental and Clinical Oncology, USSR*)
W. Schmid, M.D. (*Kinderspital, University of Zurich*)
V. S. Šljivić, M.D. (*Institute of Nuclear Sciences, Yugoslavia; International Atomic Energy Agency Fellow*)
Colonel C. E. Stuart, M.D., B.A.O., M.C.Path., D.T.M. & H. (*Royal Army Medical College*)
R. L. Tapp, Ph.D. (*University of Cambridge*)

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The Unit is studying the action of ionizing radiations on living cells. Particular attention is being paid to fast neutrons and to X- and γ-radiation.

Summary of research

PHYSICAL STUDIES

1. Commissioning of new irradiation cubicles.
2. Modification of chronic neutron irradiation tank on GLEEP to give fast neutron doses of about 70 rads in 12 weeks.
3. Dosimetry for fast neutron and γ-irradiation of mice, rats, guinea pigs, rabbits and goats in the experimental holes of BEPO.
4. Measurements of sodium-24 activity in plasma of neutron-irradiated goats.
5. Development and dosimetry of fast proton source for cellular radiobiology: development of various targets for the nuclear reaction, measurements of dose and energy distribution in irradiated specimen.
6. Improvements in electrophoretic separators.

CHEMICAL STUDIES

1. Antiradiation drugs.
2. The oxidant produced by irradiating or alarming mice.
3. Coupled autoxidation of α-angelica lactone and isolation of an oxidation dimer.
4. DNA polymerase, with attempts to produce net replication of biologically active DNA.
5. Artifically multinucleate amoeba.

PHYSIOLOGICAL STUDIES

1. Strontium balance in male breast-fed infants from 6th to 9th day after birth (in collaboration with the Department of Experimental Medicine, University of Cambridge).
2. Turnover of radioactive strontium in newborn rats (with Dr K. Kostial and Dr N. Gruden, Institute of Medical Research, Zagreb).
3. Effect of the addition of calcium and phosphorus to the diet on the retention of strontium in man.
4. Excretion of intravenously administered calcium and strontium in rats of various ages and the effect of dietary calcium on this excretion.
5. Concentration of rubidium in human tissues (in collaboration with the Health Physics and Medical Division, AERE, Harwell).
6. Effect of vitamin D on calcium and citric acid metabolism in the rat small intestine *in vitro*.
7. Carcinogenic and other effects of superficial β-radiation of mice.
8. Gastric function after, and conditioning by, whole-body or localized irradiation.
9. Sensitivity of acute and delayed responses to irradiation in relation to age, including comparisons between different kinds of penetrating radiation.
10. Quantitative aspects of recovery from whole-body irradiation and its cellular basis.
11. Modification of delayed effects of whole-body irradiation, especially neoplasia, with variations in parameters of exposure such as fractionation and dose rate.
12. Quantitative comparisons of lethal and other effects of fast-neutron radiation and γ-radiation, especially in large animals.
13. Radiation chimeras:
    (*a*) Lymphoid aplasia and secondary disease.
    (*b*) Role of the thymus in lymphopoiesis.
    (*c*) Serial passage of bone marrow.

FUNDAMENTAL STUDIES

1. Mechanisms of induction of chromosome aberrations by radiation and chemicals.
   (*a*) Studies with low-energy X-rays leading to a revision of previously accepted concepts and to a new model of aberration formation which provides a quantitative explanation of relative biological effectiveness (RBE); extension of this investigation with mono-energetic protons.
   (*b*) Analysis of the statistical distribution of aberrations between cells following various radiation treatments to investigate the nature of exchange ' sites '.
   (*c*) Investigation of recovery from the damage leading to aberration formation by use of fractionation techniques.
   (*d*) Relation between stage of cell development and sensitivity to aberration induction by radiation.
   (*e*) Relation between DNA synthesis and action of alkylating agents in aberration induction.
   (*f*) Interaction between ionizing radiation and chemical agents in aberration induction.

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2. Structure and replication of large and small chromosomes in *Allium* studied with radioactively labelled nucleosides.
3. DNA and RNA synthesis in mammalian sex chromosomes.
4. Induction of chromosome aberrations in human peripheral blood leucocytes.
5. Analysis of recovery from X-ray damage in mammalian cells cultured and irradiated *in vitro*.
6. Development of a short-term *in vitro* culture technique for *Tradescantia* microsporocytes for specialized irradiation studies.
7. X-ray-induced reversions in a strain of *Escherichia coli* (*WP2*) requiring tryptophan.
8. Cell population studies using chromosome markers in the mouse.
9. Cytogenetics of leukaemia in man.
10. Cytogenetics of neoplasia in experimental animals.
11. Factors influencing the radiosensitivity of mature mammalian cells *in vitro* (organ culture) —lymphocytes in lymph nodes, visual cells in retina: oxygen, carbon dioxide, pH, calcium, temperature, dose rate.
12. The ' paradoxical resistance ' of thymus lymphocytes to high doses of radiation (due to inhibition of some preautolytic stage in the breakdown of thymus lymphocytes after irradiation).
13. Development of respirometer for continuous measurement of the oxygen consumption of organ cultures in normal (bicarbonate-containing) media in the presence of 5% carbon dioxide.
14. Effects of pH, glucose concentration, sodium chloride concentration, etc. on (*a*) the oxygen consumption, and (*b*) the lactic acid production (aerobic glycolysis) of organ cultures of lymph nodes and of retina.
15. Organ culture under hyperbaric oxygen: development of pressurized culture chamber and some preliminary experiments with oxygen at 3 atm.
16. Uptake of fluorescent-labelled albumin by certain cells in organ cultures of various mammalian organs (with Dr G. C. Easty, Chester Beatty Research Institute).
17. Early histochemical changes in organ cultures of rat liver, especially in mitochondria and lysosomes (with Dr J. Chayen and Dr L. Bitensky, Royal College of Surgeons of England).
18. Detailed electron microscope studies of the normal ultrastructure of thymus lymph nodes, liver and retina (after various preparative procedures), as a basis for recognition of the ' normal ' range and of artefacts of preparation.

GENETICS

1. Effects of radiation dose, intensity and quality of induction of mutations in immature germ cells of *Drosophila melanogaster*.
2. Genetic effect of ^{14}C in *Drosophila melanogaster*.
3. Radiation and ageing in *Drosophila*.
4. Mutagenic effects of radiation in fish.
5. Methods for detecting and measuring mutation in mice.
6. Induction of genic and chromosomal mutations in mice by chronic γ-irradiation, acute X-irradiation and neutrons, with particular reference to the effects of dose fractionation.
7. Effects of hypothermia on the induction of mutation in the mouse.
8. Gene action in the mammalian X chromosome.
9. Genetics and development of a number of mouse mutants.
10. Investigation of the possible mutagenic effects of oral contraceptives in the mouse.

Dr. L. A. Stocken of the Department of Biochemistry, University of Oxford, who is in receipt of a Council honorarium, is engaged on work of particular interest to the Radiobiological Research Unit:

1. X-irradiation of nuclei from rat thymus gland *in vitro* and *in vivo* and the effect on thiol content.
2. Analysis of thiol-containing compounds in thymic nuclei.
3. Amino acid activation and protein synthesis in isolated nuclei.

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EXPERIMENTAL RADIOPATHOLOGY RESEARCH UNIT

Hammersmith Hospital, Ducane Road, London W.12
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Miss T. Alper, M.A., M.S.(Ed.), F.Inst.P.

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Other senior staff

D. Dowson
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Visiting and attached workers

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G. Harris, M.R.C.P. (*Hammersmith Hospital*)
U. K. Misra, Ph.D. (*University of Delhi*)
T. Zebro, M.D. (*Medical Academy, Cracow*)

Investigations on the effects of radiation on living organisms are aimed at elucidating basic mechanisms of action of ionizing radiations, especially with reference to the bearing of such studies on radiotherapy.

Summary of research

1. Electron-spin resonance signals from irradiated amino acids.
2. Mechanisms of chemical protection:
   (*a*) Linear energy transfer (LET) as a parameter in chemical protection of micro-organisms.
   (*b*) Protection of micro-organisms incorporating base analogues (ultraviolet and ionizing radiation).
   (*c*) Importance of thiol groups in protection, with particular reference to the thiourea group of compounds.
   (*d*) Competition between protective compounds and non-protective analogues.
3. Variation in biological effectiveness and in oxygen enhancement ratio with LET, and effect of post-irradiation treatments (studied in micro-organisms).
4. Survival curves for mammalian cells cultured *in vitro*, with various parameters:
   (*a*) Oxygen effect for Landschütz tumour, and comparison with results of *in vivo* assay.
   (*b*) Comparison of hamster cell line with the same strain transformed by polyoma virus.
   (*c*) Preliminary work on chemical protective agents and post-irradiation modifying treatments.
5. Comparative effects of modifying agents for several end-points in bacteria: lethal effects, effects on induction of β-D-galactosidase, and post-irradiation breakdown of DNA.
6. Modification by oxygen and other agents of the response of bacteria sensitized by incorporation of 5-bromuracil.
7. Effects of dose fractionation, tested on the following systems:
   (*a*) Small intestine of mouse, irradiated while anoxic: preliminary work to establish oxygen enhancement ratio for this end-point; comparative effects of X-rays and neutrons.
   (*b*) Haemopoietic tissue of mice, studied on the basis of 30-day survival rates and development of spleen nodules: comparative effects of X-rays and neutrons.
   (*c*) Landschütz mouse ascites tumour *in vitro*: lethal effect of radiation.
   (*d*) Landschütz mouse ascites tumour irradiated *in vivo*: induction of chromosome abnormalities.
   (*e*) Effect of dose rate, up to 50 000 rads per minute, on two modes of death in mice.
8. Modifications in polarographic system to measure oxygen tension on surface of normal and inflamed skins in humans breathing air or oxygen; search for evidence of change of blood flow produced by breathing oxygen.
9. Correlation of tumour sensitivity to radiation with type of tumour and growth rate and modification of sensitivity by oxygen; possibility of predicting oxygen effect from histological structure of a tumour.

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10. Comparative effects of X-rays and fast neutrons on bone growth (using tails of young rats).
11. Chemical protection of rat tumours, as judged by growth after irradiation.
12. Testing of various compounds reported to reduce immune response: effect assayed by scoring numbers of ascites tumour cells required to give solid tumours in adult mice.
13. Mechanism of stimulation of rabbit spleen cells by exposure to antigen: mechanism of transfer of stimulus by irradiated cells to cells not exposed to the antigen.

CLINICAL EFFECTS OF RADIATION RESEARCH UNIT

Western General Hospital, Crewe Road, Edinburgh 4
(Dean 1361)

Director
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Honorary Consultant Physician
J. A. Strong, M.B.E., M.B., F.R.C.P.E., F.R.C.P.

Scientific staff

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Miss K. E. Buckton, B.Sc.
Miss E. Day, B.A.
M. J. W. Faed, Ph.D.
D. G. Harnden, Ph.D.
Miss P. A. Jacobs, B.Sc.
Mrs. C. F. von Kuenssberg, M.B. (*part-time*)
A. O. Langlands, M.B., B.Sc., D.M.R.T., F.F.R.
Miss M. McIlree, B.Sc.
D. J. Mantle, M.R.C.S. (*until Oct. 1964*)
Miss I. M. Tough, B.Sc.
E. R. D. Williamson, M.B.

Other senior staff
A. Ross, F.I.M.L.T.

Visiting worker
T. Elsdale, Ph.D. (*Institute of Animal Genetics, University of Edinburgh*)

The work of the Unit is particularly concerned with the delayed effects of radiation exposure in man and with human cytogenetic studies.

Summary of research

1. The effects of *in vivo* X-ray exposure in man on chromosome damage, and the possible relationship of this to leukaemogenesis.
2. Cytogenetic study of former luminous dial painters (in collaboration with the Statistical Research Unit and the Radiological Protection Service).
3. Chromosome count distribution in relation to ageing.
4. Chromosome polymorphism in the general population.
5. Study of families with marker chromosomes (in collaboration with the Biochemical Genetics Research Unit and the Statistical Research Unit).
6. Sex chromosome abnormalities.
7. Viral transformation and chromosome damage.
8. Cytogenetic structure of human leukaemias, with particular reference to chronic myeloid leukaemia.
9. Organization of a registry of abnormal human karyotypes.
10. Epidemiological studies on groups of therapeutically irradiated human subjects (in collaboration with the Statistical Research Unit).

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BONE-SEEKING ISOTOPES RESEARCH UNIT

The Churchill Hospital, Headington, Oxford
(Oxford 64841)

Honorary Director
Dame Janet Vaughan, D.B.E., D.M., F.R.C.P.

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Miss P. J. Bingham, B.A.
Mrs. B. I. Bleaney, B.Sc.
G. M. Herring, D.Phil.
S. G. Kshirsagar, Ph.D.
Mrs. E. Lloyd, D.Phil.
Miss H. S. M. Macpherson, D.Phil. (*until Jan. 1964*)
Mrs. M. E. Owen, D.Phil.
Mrs. M. C. Williamson, B.Sc.

Other senior staff

Miss I. Brazell
Miss F. Schofield

The aim of the Unit is to study the effect of bone-seeking isotopes on the skeleton and bone marrow. Current research continues to be directed to certain fundamental physiological problems, in addition to problems of dosimetry in relation to carcinogenesis.

Summary of research

1. Normal cellular metabolism and the effects of different experimental conditions on the actively growing periosteal surface of the femur, studied with labelled compounds.
2. Physical characteristics, metal-binding properties and carbohydrate composition of a sialoprotein, a chondroitin sulphate and three other mucoprotein fractions isolated from bovine bone and of acellular teleost bone (Dr. A. R. Peacocke and Mr. P. Williams, Biochemistry Department, Radcliffe Infirmary, are collaborating in some of these studies).
3. Histochemical and histological character of the surfaces on which plutonium and americium are concentrated.
4. The dosimetry of plutonium on bone surfaces.
5. Distribution of radium and calculation of radiation dose in trabecular bone of human patients with radium poisoning in whom cortical bone has already been studied.
6. Kinetics of ^{45}Ca and ^{90}Sr metabolism in the rabbit, with special reference to a discrimination factor between blood and bone for strontium.
7. Occurrence of carcinomas of the ear after a 6-year latent period in young rabbits given low doses (50 μCi/kg) of ^{90}Sr by injection.

ENVIRONMENTAL RADIATION RESEARCH UNIT

University Department of Medical Physics,
The General Infirmary, Leeds 1
(Leeds 32799)

Honorary Director
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Deputy Director
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Scientific staff

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M. Kabir, M.Sc.
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Other senior staff

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Attached workers

T. R. Overton, Ph.D., A.Inst.P. (*MRC grant-holder*)
A. R. Wilson, Ph.D. (*MRC grant-holder*)

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The aims of the Unit are to assess the dose to human tissues from environmental ionizing radiations, and to consider the biological significance of this dose.

Summary of research

1. Potassium content of the human body in normal and pathological conditions, investigated by measuring the γ-ray emission from ^{40}K.
2. ^{137}Cs content of the human body.
3. Measurement of accidentally acquired radioisotopes in the human body.
4. Whole-body retention of γ-emitting radioisotopes.
5. External γ-radiation and cosmic radiation intensities, studied with a semi-automatic, continuously-recording apparatus at a fixed site.
6. Measurement of γ-radioactivity in soil and biological specimens.
7. Measurement of β-radioactivity in soil and other materials, and the estimation of the external β-ray dose to superficial tissues.
8. Theoretical and experimental studies on the radiation dosimetry of radioactive materials in bone.
9. Theoretical studies of the mechanism of carcinogenesis, with particular reference to radiation carcinogenesis.
10. Theoretical studies of the pathogenesis of auto-immune diseases, with particular reference to the effect of radiation on ageing processes.
11. Measurement of cosmic-ray neutron dose.
12. Measurement of radiation dose to marrow in trabecular bone by means of thermoluminescent dosimetry.

RADIOLOGICAL PROTECTION SERVICE

(Jointly with the Ministry of Health)

Clifton Avenue, Belmont, Sutton, Surrey

(Vigilant 9121)

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Deputy Director

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Mrs. G. D. Parry Howells, Ph.D.
A. P. Hudson, B.Sc. (*until Sept. 1964*)
B. E. Jones, B.Sc., A.Inst.P.
H. G. Jones, Ph.D. (*died Nov. 1964*)
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L. J. F. Brotherton
P. N. Casbolt
J. J. Cleary
J. W. Davies, Dip.Tech.
E. Greenslade
A. E. Greinig, Grad.Brit.I.R.E.
C. L. Harvey
P. B. Roberts, A.I.S.T.
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BIRMINGHAM REGIONAL CENTRE

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LEEDS REGIONAL CENTRE

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MANCHESTER REGIONAL CENTRE

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Other senior staff
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SCOTTISH CENTRE

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Honorary Director
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Scientific staff
N. T. Harrison, B.Sc., A.Inst.P. D. A. Simpson, B.Sc.

Other senior staff
G. C. Jardine

The aims of the Service are to carry out research of a physical nature into problems concerning the protection of workers and of the public from the effects of ionizing radiations, and to act as a central organization for the control of radiation hazards.

Summary of activities

COLLECTION AND DISSEMINATION OF INFORMATION

1. Assistance to the Medical Research Council's Committee on Protection against Ionizing Radiations and to its subcommittees and panels in the preparation of recommendations on the permissible levels of external and internal radiation for radiological workers and for members of the public.

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2. Assistance to the Radioactive Substances Advisory Committee and its panels and also to various governmental committees in the preparation of codes and regulations for the control of radiation hazards.
3. Participation in the work of the International Commissions on Radiological Protection and on Radiological Units and Measurements.
4. Collection of data on the metabolic behaviour of radionuclides and stable elements in humans, and the assessment of maximum permissible body burdens and of concentrations in air and in water of a number of radionuclides.
5. Collection of data on the effects of radiation; estimates of risk per unit dose.
6. Assistance to various committees of the British Standards Institution and other national and international bodies.

RADIATION MONITORING AND ADVISORY SERVICES

1. Operation of a personnel radiation-monitoring service employing punched card techniques for the recording, analysing and processing of the results of tests and of the cumulative totals of radiation exposure of workers.
2. Inspection of departments and sites where radiation hazards may exist, either as a result of normal operating procedures or of accidents.
3. General advisory services regarding the design of radiation departments and the reduction of hazards in new uses of radioactive isotopes.
4. Measurement of amounts of various nuclides deposited in the bodies of persons exposed to unsealed radioactive materials, either during normal use or as the result of accidents.
5. Miscellaneous measurements of environmental radioactivity, e.g. continuous measurement of the local γ-radiation due to fallout and measurement of the natural radioactivity of some drinking waters.
6. Tests of the effectiveness of protective materials.

MISCELLANEOUS RESEARCHES

1. Improvement of the accuracy of techniques for measuring external radiation received by workers:
   (*a*) Improvement of methods of film dosimetry.
   (*b*) Improvement of track plate methods for neutron dosimetry.
   (*c*) Development of equipment for measuring low-energy X-rays.
   (*d*) Sensitivity of equipment used for radiation surveys.
2. Automation in film densitometry and dose evaluation.
3. Development of new techniques for assessing the amount of radioactive material deposited in the body, including whole-body measurements, measurement of radon in breath and chemical tests of excreta.
4. Measurement of radium body burdens of further persons formerly engaged in the luminizing industry, bringing the total number studied to about 530 (with Dr. J. T. Boyd, Statistical Research Unit).
5. Investigation of current practice in radium luminizing to determine if there is any relationship between radium in the bodies of workers and in the working environment.
6. Relationship in humans between radium in the body and radon in breath.
7. Investigation of current practice in the use of tritium luminous compound and of mechanisms whereby tritium can enter the bodies of workers.
8. ^{40}K in humans and its relationship to obesity and pregnancy (with Dr. G. R. Wadsworth, Queen Elizabeth College, London).
9. Fallout ^{137}Cs in members of the population.
10. Variations in local γ-ray background due to nuclear weapon tests.
11. Stable isotope concentrations in organs of the body studied by neutron activation and other methods.
12. Variation of organ weights with age.
13. Distribution in different organs and retention in the body of organic compounds tagged with ^{14}C and ^{3}H, including observations on humans and on experimental animals.
14. Manufacture and use of solid-state devices for the absolute calibration of very low levels of radioactive materials and for α-ray spectrometry.
15. Electronic equipment for radiation measurements, particularly utilizing transistors.
16. Theoretical and practical studies on the scattering of X- and γ-radiation from surfaces and volumes; design of maze entrances; investigation of airshine.

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17. Investigation into the protective properties of various materials (e.g. water, concrete, paraffin wax) against fast neutrons.
18. Investigation on the performance of available neutron site-monitoring equipment and development of new designs, with emphasis on improved portability and sensitivity.
19. Establishment of a service for the leakage testing of sealed sources.
20. Establishment of a service for instrument calibration.

CYCLOTRON UNIT

Hammersmith Hospital, Ducane Road, London W.12
(Shepherds Bush 4594)

Director
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Scientific staff

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S. B. Field, Ph.D.
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A. W. Goolden, M.B., D.M.R.T. (*honorary*)
T. Jones, M.Sc.
Miss C. M. E. Matthews, Ph.D.
R. L. Morgan, M.B., B.Sc., D.M.R.T., F.F.R. (*part-time*)
C. J. Parnell, B.Sc.
T. E. Saxton, B.Sc.
J. Sharp, B.Sc.
D. J. Silvester, Ph.D.
Mrs. J. A. Silvester, B.Sc. (*until Apr. 1964*)
P. C. R. Turner, M.Sc.

Other senior staff

L. C. Baker, F.I.S.T.
M. B. Coyne
K. Finding, A.M.I.Mech.E.
G. F. S. Harding
R. J. Post, A.M.I.E.E.

This Unit, which is responsible to the Council's Radiation Facilities (Hammersmith) Committee, has three main functions. These are to produce with the cyclotron those radioactive isotopes not available from other sources and to collaborate in the investigation of their clinical value; to provide facilities for collaborative radiobiological investigation using the radiations from the cyclotron, linear accelerator and the Van de Graaff machine; and to provide facilities for research in fast-neutron therapy with the cyclotron.

Summary of research

1. Clinical use of cyclotron-produced radioactive isotopes:
   (*a*) ^{124}I in the treatment of thyroid disease (in collaboration with the Department of Radiotherapy).
   (*b*) ^{15}O, ^{11}C and ^{13}N in pulmonary and circulatory studies (in collaboration with the Postgraduate Medical School).
   (*c*) ^{18}F in dental studies (isotope material supplied to the London Hospital Medical College).
   (*d*) ^{52}Fe in studies of iron metabolism after ^{32}P treatment (isotope material supplied to the Royal Marsden Hospital).
2. Investigations associated with the use of cyclotron-produced isotopes:
   (*a*) Development of a positron camera for *in vivo* isotope distribution studies.
   (*b*) Comparison of coincidence counting of positron-emitting isotopes and counting with focussing collimators, using various isotopes, for brain tumour localization.
   (*c*) Use of an analogue computer in the measurement of regional ventilation with ^{133}Xe and ^{13}N.
   (*d*) Development of mathematical models to interpret the indicator dilution curve.
   (*e*) Investigation of the concentration of niobium isotopes in rat tumours.
   (*f*) Control of ventilation using CO_2 and analogue computer (in collaboration with the Postgraduate Medical School).
   (*g*) Use of ^{129}Cs to study blood flow in heart muscle (in collaboration with the Postgraduate Medical School).

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3. Investigations associated with the production of radioisotopes by the cyclotron:
   (*a*) Development of new methods of preparation of isotopes in high specific activity.
   (*b*) Preparation of labelled compounds with high specific activity.
   (*c*) Absolute standardization of cyclotron-produced isotopes.
   (*d*) Radioactivation analysis with the cyclotron.
   (*e*) Radiochemical investigations associated with the heavy-ion beam project.
4. Variation of relative biological efficiency with dose, linear energy transfer of radiation and concentration of oxygen, on the basis of survival of human kidney cells and bacteria exposed to X-rays and deuterons of various energies (with Dr. G. W. Barendsen of the Radiological Institute, Rijswijk, Netherlands, and members of the Experimental Radiopathology Research Unit).
5. Development of fast-neutron dosimetry.
6. Radiobiological experiments with fast neutrons to determine:
   (*a*) The comparative effect of fast neutrons and 8-MeV X-rays with various fractionation schemes, using the skin of pigs and mice.
   (*b*) The relative biological efficiency of the fast-neutron beam for various biological systems (in collaboration with the Experimental Radiopathology Research Unit, the Churchill Hospital, Oxford, and St. Mary's Hospital, Paddington).
7. Engineering studies:
   (*a*) Investigation of the conditions in the cyclotron for accelerating ions of heavy nuclei, such as nitrogen and helium-3, to high energies by methods compatible with normal functioning of the machine.
   (*b*) Study of the operation of the cyclotron in order to improve efficiency for users.
   (*c*) Design and construction of a beam-monitoring equipment to provide records of instantaneous and integrated beam current from the cyclotron.
8. Use of 8-MeV X-ray and electron beams for radiobiological studies, particularly in relation to protection by anoxia (in collaboration with the Experimental Radiopathology Research Unit and Dr. E. A. Wright and Dr. N. A. Sharples of St. Mary's Hospital, London).

CLINICAL GENETICS RESEARCH UNIT

Institute of Child Health, The Hospital for Sick Children,
Great Ormond Street, London W.C.1
(Holborn 9200)

Director

C. O. Carter, B.M., F.R.C.P.*
J. A. Fraser Roberts, C.B.E., M.D., D.Sc., F.R.C.P., F.R.S. (*until Sept. 1964*)

Scientific staff

Miss H. Blyth, M.B., D.Obst.R.C.O.G.
Miss M. I. Dunsdon, Ph.D.
R. M. C. Huntley, B.A., B.Ed.
D. J. Mantle, M.R.C.S.
Mrs. J. Slack, B.M., D.C.H. (*part-time*)
J. Wilson, M.B., B.Sc., M.R.C.P.

The main work of the Unit falls under two headings: (*a*) the study of genetic and other factors in the causation of developmental abnormalities in man; and (*b*) investigation of the role of inheritance in the causation of common diseases, with some parallel studies on normal human variation.

Summary of research

1. The aetiology, and especially the genetics, of the common congenital abnormalities, for example congenital pyloric stenosis, spina bifida cystica, congenital heart disease, inguinal hernia, harelip and cleft palate and congenital dislocation of the hip.
2. Down's syndrome (mongolism): chromosome studies in relation to family history and maternal age (in collaboration with the Department of Paediatric Research, Guy's Hospital, London).
3. Childhood muscular dystrophies: serum enzyme levels in known heterozygotes (in collaboration with the Department of Chemical Pathology, The Hospital for Sick Children).
4. Family studies on coronary artery disease, including estimations of serum lipoprotein lipase and sugar tolerance.

* Dr. Carter, already a member of the staff of the Unit, succeeded Dr. Fraser Roberts on the latter's retirement from the Council's staff in October 1964.

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5. Quantitative human variation: physical and mental measurements on a series of twins and their relatives to obtain estimates of degrees of resemblance.
6. The role of inheritance in hypertension and diabetes mellitus.
7. Associations between blood groups and disease.

POPULATION GENETICS RESEARCH UNIT

Old Road, Headington, Oxford
(Oxford 62834)

Director
A. C. Stevenson, M.D., B.Sc., D.P.H., F.R.C.P.

Scientific staff

A. Barr, Ph.D. (*part-time*)
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Miss B. C. C. Davison, M.B., D.P.H.
Miss S. A. Goodfellow, B.Sc. (*until Dec. 1964*)
H. A. Johnston, M.B., D.P.H.
C. B. Kerr, M.B.
D. F. B. Roberts, D.Phil.
I. B. Shine, M.B.
R. S. Wells, M.B., M.R.C.P., D.C.H. (*until Jan. 1965*)

Other senior staff

Mrs. J. Bedford, B.Sc.
G. Clarke

Visiting worker
S. Armendares, M.D. (*Instituto Mexicano del Seguro Social, Mexico City*)

The Unit is concerned primarily with work designed to illuminate the genetic structure of human populations by means of the pattern of distribution of traits of medical importance. The cytological laboratory is concerned with the relationship of chromosomal aberrations to developmental anomalies, abortions and infertility. Four advice and referral clinics are held monthly in the hospitals of the Oxford Regional Hospital Board.

Summary of research

1. Frequency of congenital anatomical abnormalities in different areas of the world and in different ethnic groups: parallel studies in sixteen countries organized on behalf of the World Health Organization.
2. Frequency and clinical and genetic variation of ichthyosis vulgaris in Berkshire.
3. Frequency and clinical and genetic variation of tylosis, epidermolysis bullosa, the ectodermal dystrophies, and alopecia in Oxford Regional Hospital Board area.
4. Ascertainment of harmful sex-linked traits in Oxford Regional Hospital Board area; the 'load' on the X chromosome in man.
5. Analysis of population data from the study of a 90 per cent sample of the population of an island.
6. Severe rapidly progressive muscular dystrophy in girls in England and Wales.
7. Lactate dehydrogenase and α-hydroxybutyrate dehydrogenase izoenzymes in muscle and serum in sex-linked muscular dystrophy.

MUTAGENESIS RESEARCH UNIT

Institute of Animal Genetics, West Mains Road, Edinburgh 9
(Newington 1081)

Honorary Director
Miss C. Auerbach, D.Sc., F.R.S.

Scientific staff

B. M. Cattanach, Ph.D.
C. H. Clarke, Ph.D.
J. Corran, B.A.
Mrs. M. E. Griffiths, B.Sc.
B. J. Kilbey, Ph.D.
C. Mathew, M.Sc. (*until Dec. 1964*)
B. M. Slizynski, Ph.D.

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Attached workers

M. J. Allison, B.Sc. (*MRC Scholar*)
N. Anwar, M.Sc. (*British Council Fellow*)
V. L. Chopra, B.Sc. (*University of Edinburgh*)
Mrs. A. R. Kemp, B.Sc. (*MRC Scholar*)

The Unit is engaged in an analysis of the process of mutation, with particular emphasis on factors modifying this process in its various stages.

Summary of research

1. Bacteria:
   Attempts to study mutagen specificity by means of the transforming principle.
2. *Neurospora:*
   (*a*) Analysis of mutagen specificity, using reverse mutations to prototrophy.
   (*b*) Analysis of delayed effects and mosaicism, using the recessive lethal technique.
3. *Schizosaccharomyces pombe:*
   (*a*) Analysis of the interaction of L-methionine with the expression of reverse mutations to adenine-independence and with other aspects of adenine biosynthesis.
   (*b*) Genetic analysis of spontaneous and induced adenine reverse mutations for the presence of suppressor mutations.
   (*c*) Analysis of the mode of action of nitrous acid and other mutagens by means of adenine mutations affecting colony colour.
   (*d*) Mutagen specificity for the induction of suppressor mutations studied in a methionine reverse mutation system (with Dr. N. Loprieno, Istituto di Genetica, Pisa).
4. *Drosophila:*
   Delayed mutagenic action of alkylating agents and of calf thymus DNA.
5. Cytological studies:
   (*a*) Puff formation in polytene chromosomes of *Drosophila melanogaster* in relation to changes in cellular function.
   (*b*) Behaviour of microchromosomes and macrochromosomes in a hybrid, *Anas clypeata/Anas penelope.*
   (*c*) Some factors influencing the length of the spermatogenetic wave.
   (*d*) Sex chromosomes and nucleolus in spermatocytes of the ' flecked ' translocation.

PSYCHIATRIC GENETICS RESEARCH UNIT

Institute of Psychiatry, Maudsley Hospital, Denmark Hill, London S.E.5
(Rodney 9600 or 8585)

Director

E. T. O. Slater, M.D., F.R.C.P., D.P.M. (*part-time*)

Scientific staff

Mrs. J. G. Carr, B.A. (*part-time*)
Mrs. Valerie A. Cowie, M.D., D.P.M. (*part-time*)
J. Kahn, Ph.D.
Miss E. J. McIver, B.Sc. (*until Sept. 1964*)

Other senior staff

Miss V. G. Seal

Visiting and attached workers

I. I. Gottesman, Ph.D. (*Harvard University*)
E. Kringlen, M.D. (*Universitets Psykiatriske Klinikk, Oslo*)
J. Shields, B.A. (*Institute of Psychiatry*)
Ming-tso Tsuang, M.D. (*National Taiwan University Hospital, Taipei, Formosa*)

The work of this Unit deals with the effect of genetic factors in producing all types of mental ill-health (including mental deficiency, personality disorders, neurotic disturbances and the so-called organic and functional psychoses). Within this large field problems are chosen where conditions seem propitious for some advance in knowledge—because appropriate material is available, for instance, or because methodological advances have made the problems amenable to solution. An example of such a problem is the investigation of genetic–environmental interactions in a large collection of twins whose records are available at the Institute of Psychiatry.

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Summary of research

1. Family, social and psychometric investigation of schizophrenic twins admitted to the Maudsley Hospital since 1948.
2. Family histories and backgrounds of delinquent girls admitted to a classifying school.
3. Psychological factors in the lives of delinquent girls admitted to a classifying school and follow-up studies.
4. Follow-up study of monozygotic and same-sexed dizygotic twin pairs of which one member has been under treatment for neurosis or psychopathy.
5. Ten-year follow-up study of the social adjustment of twin schoolchildren.
6. Chromosome studies of mongols born to young mothers or to old fathers (with Dr. R. G. Chitham, Queen Mary's Hospital for Children, Carshalton).
7. Chromosome survey of mentally subnormal children with physical abnormalities admitted to Queen Mary's Hospital for Children, Carshalton.
8. Hormonal factors in mothers of mongols (with Dr. A. J. Coppen, St. Ebba's Hospital, Epsom, and Dr. Margaret Stern, Chelsea Hospital for Women).
9. Incidence of phenylketonuria in children at approved schools.
10. A multidimensional study of mongolism in a population-based sample, with chromosomal, dermatoglyphic and general clinical investigations and a longitudinal study of neurological development beginning in the neonatal period.
11. A survey of a sample of mentally subnormal patients, taking congenital cardiac defect as the index lesion.
12. Birth order and maternal age in psychiatric patients.
13. A study of pairs of sibs both treated in hospital for mental illness.
14. Chromosome studies of cases of psychiatric significance referred by hospital sources.

EXPERIMENTAL GENETICS RESEARCH UNIT

Department of Animal Genetics, University College London, Gower Street, W.C.1

(Euston 7050)

Honorary Director

Professor H. Grüneberg, M.D., D.Sc., F.R.S.

Scientific staff

M. S. Deol, Ph.D.
Miss G. M. Truslove, Ph.D.
Mrs. L. E. Riles, M.A.

Visiting and attached workers

S. L. Beck, Ph.D. (*University of Michigan*)
D. R. Johnson, B.Sc. (*MRC Scholar*)
Miss H. Randelia, M.Sc. (*Indian Cancer Research Centre, Bombay*)

The Unit is concerned with the study of inherited diseases in laboratory animals, and its application to medicine. Investigations include the genetic analysis of the pathological conditions themselves, a study of the various genetic backgrounds on which they can manifest themselves, and a study of the pathology and development of these conditions.

Summary of research

1. Pathology of development of skeletal mutants in the mouse.
2. Minor skeletal variation in inbred strains of mice.
3. Skeletal variation in wild populations of mice and other rodents.
4. Labyrinthine mutants in the mouse.
5. Cerebral degeneration in the mouse.
6. Genes affecting embryonic haemopoiesis.
7. A search for differences in proteins and smaller molecules associated with genes ascertained through their morphological effects.
8. A search for effects in adult life of genes ascertained through their effects in early development.
9. A search for genetic effects of radiation in areas with high background radiation (Kerala, South India).
10. Genes and genotypes affecting the dentition of the mouse.

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MICROBIAL GENETICS RESEARCH UNIT

Hammersmith Hospital, Ducane Road, London W.12
(Shepherds Bush 4594)

Director
W. Hayes, M.B., D.Sc., D.P.H., F.R.C.P.I., F.R.S.

Scientific staff

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P. M. A. Broda, B.A.
R. C. Clowes, Ph.D.
K. W. Fisher, Ph.D.
S. W. Glover, Ph.D.
J. D. Gross, Ph.D.
R. H. Pritchard, Ph.D. (*until Sept. 1964*)
J. G. Scaife, Ph.D.
K. A. Stacey, Ph.D.
N. D. Symonds, Ph.D.

Visiting and attached workers

J. Aronovitch, Ph.D. (*Hebrew University Medical School, Jerusalem*)
J. R. Beckwith, Ph.D. (*University of Princeton*)
C. Colson, Dr.Sci. (*University of Louvain*)
R. Devoret, M.D. (*CNRS, Gif-sur-Yvette*)
J. M. Erskine, B.Sc. (*New Zealand Dairy Research Fellow*)
Z. Evenchik, Ph.D. (*Israel Institute for Biological Research*)
D. M. Goldfarb, M.D. (*Gamaleya Institute, Moscow*)
Mrs. T. Gottfried, B.Sc. (*University of Pennsylvania*)
D. Karamata, B.Sc. (*University of Geneva*)
M. S. Kelly, M.Sc. (*MRC Scholar*)
Miss A. M. Macfarren, B.Sc. (*MRC Scholar*)
Mrs. E. Meynell, M.B. (*MRC grant-holder*)
Miss M. Monk, M.Sc. (*University of Melbourne*)
A. Pekhov, Dr.Biol. (*Institute of Experimental Biology, Moscow*)
S. D. Silver, Ph.D. (*Massachusetts Institute of Technology*)
G. Venema, Ph.D. (*University of Groningen*)
R. Weisberg, Ph.D. (*California Institute of Technology*)

Micro-organisms in recent years have proved to be uniquely adapted to highly refined analyses of genetic structure, organization and function. The Unit is undertaking detailed study of the fine structure of genes and chromosomes in micro-organisms and the mechanisms of their replication and transfer to other cells (i.e. sexuality). Research is concerned primarily with the genetics of bacteria and their viruses, which are relevant to such problems as virulence, resistance to antibiotics and host–virus relationships.

Summary of research

1. Nature of bacterial death following deprivation of thymine, and its relationship to the induction of lysogenic bacteria.
2. Nature of chromosome mobilization and transfer by male cells of *Escherichia coli* following conjugation.
3. Genetic and physico-chemical basis of host-induced modification in bacteria and bacteriophages.
4. Structure and genetic behaviour of determinants of colicin production and other characters determined by episomal genes in bacteria.
5. Mapping of the chromosome of *Bacillus subtilis* by transformation, and the kinetics of transformation in this organism.

CELL GENETICS RESEARCH UNIT

Department of Genetics, The University of Glasgow, Glasgow W.2
(Western 8855)

Honorary Director
Professor G. Pontecorvo, Ph.D., F.R.S.E., F.R.S.

Scientific staff
Mrs. J. M. Macnab, B.Sc.

This Unit, which was established in October 1964, is concerned with genetic analysis at the cellular level in human and other tissue.

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Summary of research

1. Induction of whole chromosome segregations in cultured human cells.
2. A search for conditions determining the division in culture of human peripheral blood lymphocytes.

MICROBIAL SYSTEMATICS RESEARCH UNIT

The University, University Road, Leicester
(Leicester 50000)

Director
P. H. A. Sneath, M.D., Dip.Bact.

This Unit, which was established in October 1964, is engaged in research on the classification of micro-organisms, with special reference to numerical taxonomy and computer methods. The application of these methods to other fields of medical and biological science is also being explored.

Summary of research

1. Systematics of pseudomonads and related bacteria.
2. Influence of environment on the classification of bacteria.
3. New statistical methods in taxonomy.
4. Systematic study of primary structure of proteins.
5. Development of computer programs for systematics.

HUMAN BIOCHEMICAL GENETICS RESEARCH UNIT

Department of Biochemistry, King's College, Strand, London W.C.2
(Temple Bar 5454)

Honorary Director
Professor H. Harris, M.D.

Scientific staff

Mrs. K. F. Bamford, Ph.D. (*part-time*) (*until Dec. 1964*)
T. E. Cleghorn, M.D. (*honorary*)
R. A. Fildes, Ph.D.
Miss A. M. Glen-Bott, M.B., D.Obst.R.C.O.G.
D. A. Hopkinson, M.B.
Mrs. P. M. H. Mazumdar, M.B.
Miss E. B. Robson, Ph.D.

The aim of the Unit is to study the biochemical genetics of inherited disease and of normal variation in man.

Summary of research

1. Human enzyme polymorphisms and variants: their genetical and biochemical basis and clinical significance, with particular reference to serum cholinesterase, red cell acid phosphatase, 6-phosphogluconate dehydrogenase, lactic dehydrogenase, phosphoglucomutase, placental alkaline phosphatase and adenylate kinase.
2. Electrophoretic studies on inherited variants of serum proteins.
3. Quantitative and qualitative studies on serum alkaline phosphatase in relation to the ABO blood groups and the secretor status and to gastrointestinal disease (in collaboration with the Statistical Research Unit).
4. Biochemical markers in twin studies: a survey of all multiple births in Birmingham (with Dr. J. H. Edwards, Department of Social Medicine, University of Birmingham).
5. Enzyme studies on tissue cultures and clones derived from individuals of known genotype.
6. Linkage studies (in collaboration with the Clinical Effects of Radiation Research Unit).

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BIOPHYSICS RESEARCH UNIT

Department of Biophysics, University of London, King's College,
26–29 Drury Lane, London W.C.2
(Temple Bar 8851)

Director

Professor Sir John Randall, D.Sc., F.R.S. (*part-time*)

Deputy Director

Professor M. H. F. Wilkins, C.B.E., Ph.D., F.R.S.

Honorary Biological Adviser

Professor Dame Honor B. Fell, D.B.E., D.Sc., F.R.S.

Scientific staff

J. B. Alexander, B.Sc.
S. Arnott, Ph.D.
Miss A. I. Bailey, Ph.D.
Mrs. A. V. W. Brown, Ph.D. (*part-time*)
G. L. Brown, Ph.D.
H. G. Davies, Ph.D.
G. F. Elliott, Ph.D.
Miss E. J. Hanson, Ph.D.
Mrs. S. Lee, Ph.D.
J. Lowy, Ph.D.
D. W. McMullen, B.Sc.
Mrs. C. A. Male, B.A. (*until Oct. 1964*)
B. M. Millman, Ph.D.
S. R. Pelc, D.Phil.
B. M. Richards, Ph.D. (*until Sept. 1964*)
E. G. Richards, Ph.D. (*until Sept. 1964*)
M. Spencer, Ph.D.
J. R. Warr, Ph.D.
M. R. Watson, M.Sc.
Miss M. G. E. Welton, B.Sc.

Other senior staff

J. M. Hopkins
Miss R. D. Hynes
R. L. Jones, A.I.S.T.
H. R. Munden, F.I.S.T.
Z. Kosinski, M.Sc.

Visiting and attached workers

Gabriella Augusti-Tocco, M.D. (*Laboratorio Internazionale di Genetica e Biofisica, Naples*)
J. N. Champness, B.Sc. (*MRC Scholar*)
P. M. D. Hardwicke, B.Sc. (*MRC Scholar*)
Professor F. Hutchinson (*Yale University*)
P. McPhie, B.Sc. (*MRC Scholar*)
E. H. Medlin (*University of Adelaide*)
J. F. Pardon, B.Sc. (*MRC Scholar*)
W. J. Pigram, B.Sc. (*MRC Scholar*)
Miss E. M. Rome, B.Sc. (*MRC Scholar*)

The Unit studies large molecules and the structures into which they are organized in cells and tissues, in order to gain insight into the ways in which cells work. Techniques such as X-ray diffraction, electron microscopy, microspectrometry, molecular fractionation and autoradiography are used.

Summary of research

1. Primary and secondary structure of RNA; role of RNA in protein synthesis.
2. X-ray investigation of the structures of RNA, DNA and nucleoprotein.
3. Contraction in muscle and bacterial flagella studied by electron microscopy and X-ray diffraction; associated biochemical studies on structural proteins.
4. Fine structure in cells and tissues in relation to biological function:
   (*a*) Interrelationship of nucleus and cytoplasm.
   (*b*) Fine structure of chromosomes.
5. Development of kinetosomes and their associated cilia and flagella examined structurally and biochemically as a problem in morphogenesis and protein synthesis.

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LABORATORY OF MOLECULAR BIOLOGY

University Postgraduate Medical School, Hills Road, Cambridge
(Cambridge 48011)

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M. F. Perutz, C.B.E., Ph.D., F.R.S.

Deputy Chairman
J. C. Kendrew, C.B.E., Sc.D., F.R.S.

Honorary Advisers
Sir Lawrence Bragg, O.B.E., M.C., F.R.S.
W. Cochran, Ph.D., F.R.S.

STRUCTURAL STUDIES

Scientific staff

J. C. Kendrew, C.B.E., Sc.D., F.R.S. (*Head of Division*)
U. W. Arndt, Ph.D.
D. M. Blow, Ph.D.
W. Bolton, Ph.D.
W. Brown, Ph.D.
Miss J. M. Cox, B.A.
R. Diamond, Ph.D.
J. T. Finch, Ph.D.
Miss L. C. G. Goaman, Ph.D.
T. H. Gossling, M.A.
K. C. Holmes, Ph.D.
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A. Klug, Ph.D.
R. Leberman, Ph.D.
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J. F. C. Mallett, B.A.
B. W. Matthews, Ph.D.
Miss H. Muirhead, B.A. (*until Dec. 1963*)
M. G. Rossman, Ph.D. (*until Jan. 1964*)
H. C. Watson, Ph.D.

Other senior staff

J. A. L. Fasham, Grad.I.E.E. (*until Jan. 1965*)
S. W. Greenwood, M.I.R.E. (*until May 1964*)

Visiting and attached workers

L. J. Banaszak, Ph.D. (*University of Indiana*)
J. Berger, M.D. (*National Institutes of Health*)
P. A. Bretscher, B.A. (*MRC Scholar*)
Y.-S. Chang, Ph.D. (*Institute of Biochemistry, Shanghai*)
R. A. Crowther, B.A. (*MRC Scholar*)
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A. B. Edmundson, Ph.D. (*Rockefeller Foundation, New York*)
S. C. Harrison, A.B. (*Harvard University*)
A. D. Kaiser, Ph.D. (*Stanford University, California*)
R. Kretsinger, Ph.D. (*Massachusetts Institute of Technology*)
E. L. McGandy, Ph.D. (*University of Boston*)
F. S. Mathews, Ph.D. (*Massachusetts Institute of Technology*)
L. Mazzarella, Doct.Chem. (*University of Naples*)
C. L. Nobbs, Ph.D. (*University of Auckland, New Zealand*)
E. J. O'Brien, B.A. (*Rockefeller Scholar*)
J. W. Prothero, Ph.D. (*University of Western Ontario*)
M. K. Reedy, M.D. (*University of Washington, Seattle*)
A. J. Rowe, Ph.D. (*Senior Beit Fellow*)
B. P. Schoenborn, Ph.D. (*University of California*)
P. B. Sigler, Ph.D. (*National Institutes of Health*)
I. Tinoco, Ph.D. (*University of Wisconsin*)

MOLECULAR GENETICS

Scientific staff

F. H. C. Crick, Ph.D., F.R.S. } (*Joint Heads of Division*)
S. Brenner, M.B., D.Phil., F.R.S. }
Mrs. M. L. Barnett, B.Sc.
B. F. C. Clark, Ph.D.
Miss H. Lamfrom, Ph.D. (*until Aug. 1964*)
R. E. Monro, Ph.D.
J. D. Smith, Ph.D.
A. O. W. Stretton, Ph.D.
R. J. Watts-Tobin, Ph.D.

* The Heads of Divisions and Dr. Huxley are the members of the governing board of the Laboratory.

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Visiting and attached workers

J. R. Beckwith, Ph.D. (*Harvard University*)
H. A. Bøye, B.A. (*University of Copenhagen*)
M. S. Bretscher, B.A. (*Salters' Scholar*)
W. F. Dove, Ph.D. (*California Institute of Technology*)
J. W. Drake, Ph.D. (*University of Illinois, Urbana*)
R. P. Freedman, B.A. (*MRC Scholar*)
H. M. Goodman, Ph.D. (*Massachusetts Institute of Technology*)
S. Kaplan, Ph.D. (*University of California*)
P. M. Knopf, Ph.D. (*Massachusetts Institute of Technology*)
Miss H. Lamfrom, Ph.D. (*California Institute of Technology*)
G. S. Martin, B.A. (*MRC Scholar*)
J. R. Menninger, Ph.D. (*Harvard University*)
R. H. Rownd, Ph.D. (*Harvard University*)
Professor L. Sachs, Ph.D. (*Weizmann Institute of Science, Israel*)
A. S. Sarabhai, B.A. (*MRC Scholar*)
E. R. Signer, Ph.D. (*Massachusetts Institute of Technology*)
F. W. Stahl, Ph.D. (*University of Oregon*)
A. Tissieres, M.D., Ph.D. (*University of Geneva*)
R. R. Traut, Ph.D. (*Rockefeller Foundation, New York*)
A. A. Travers, B.A. (*MRC Scholar*)
D. Zipser, Ph.D. (*Harvard University*)

PROTEIN CHEMISTRY

Scientific staff

F. Sanger, C.B.E., Ph.D., F.R.S. (*Head of Division*)
R. P. Ambler, Ph.D.
W. R. Gray, Ph.D. (*until Aug. 1964*)
J. I. Harris, Ph.D.
B. S. Hartley, Ph.D.
J. Hindley, Ph.D.
Miss D. A. Kauffman, B.A.
C. Milstein, Ph.D.
K. Murray, Ph.D.
R. N. Perham, B.A. (*until Feb. 1965*)
L. F. Smith, Ph.D.
J. Williams, M.B., B.Sc.

Visiting and attached workers

W. S. Allison, Ph.D. (*Brandeis University, Waltham, Mass.*)
J. R. Brown, Ph.D. (*University of Washington, Seattle*)
G. G. Brownlee, B.A. (*MRC Scholar*)
P. J. G. Butler, B.A. (*MRC Scholar*)
B. Foltmann, Ph.D. (*University of Copenhagen*)
Professor J. Larner, Ph.D. (*Western Reserve University, Cleveland, Ohio*)
K. Marcker, Ph.D. (*Royal Dental College, Copenhagen*)
D. Marinkovic, Dip.Chem. (*Institute of Nuclear Science, Belgrade*)
D. J. Marsh, B.A. (*DSIR Scholar*)
R. E. Offord, B.A. (*MRC Scholar*)
R. N. Perham, B.A. (*University of Cambridge*)
Professor L. B. Smillie, Ph.D. (*McMaster University, Hamilton, Ontario*)
A. G. Weeds, B.A. (*MRC Scholar*)

The aim of the Laboratory is the study of the structure, function and synthesis of large molecules of biological importance. In the divisions of structural studies and of protein chemistry, crystalline proteins (including enzymes), muscle, nucleic acids and viruses are studied by both physical and chemical methods. The division of molecular genetics is concerned with the biosynthesis of proteins and its genetic control.

Summary of research

STRUCTURAL STUDIES

1. Refinement of atomic model of myoglobin: the resolution of the Fourier synthesis has been raised from 2·0 Å to 1·4 Å and the atomic co-ordinates are taken through successive cycles of refinement, each time the accuracy of the existing co-ordinates being increased and atoms whose positions were formerly unknown being added (in collaboration with the Royal Institution). Investigation by X-ray methods of the mode of attachment of ligands in myoglobin.
2. Complete determination by chemical methods of the sequence of amino acids in sperm whale myoglobin.
3. Development of automatic counter spectrometers for extending the three-dimensional Fourier of horse haemoglobin to a resolution of 2 Å (in collaboration with the Royal Institution).
4. X-ray study of reduced human and horse haemoglobins, with a view to gaining better understanding of the oxygenation process.
5. Theoretical work in protein crystallography: development of a mathematical function for finding the symmetry of protein molecules in crystals and for the determination of phases; development of methods for refinement of partly determined structure of very complex molecules.

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6. Crystal structure of chymotrypsin.
7. Use of new heavy-atom derivatives in an attempt at phase determination by the method of isomorphous replacement in an X-ray study of tobacco mosaic virus.
8. Degradative studies on turnip crinkle virus and the reconstitution of the virus from its constituent parts.
9. Investigation of heavy-atom derivatives of crystalline tomato bushy stunt virus and turnip yellow virus, to determine the phases of the X-ray reflexions.
10. Electron microscope studies on the arrangement of subunits in viruses.
11. Structure of striated muscle and of the muscle proteins, with particular reference to the mechanism of contraction.
12. Development and use of techniques for the examination of nucleic-acid-containing structures in the electron microscope.
13. Crystal structure of glyceraldehyde phosphate dehydrogenase.

MOLECULAR GENETICS

1. Mutants, especially of the acridine type, of the r_{II} locus of the bacteriophage *T4*.
2. The amber mutants of the head protein of phage *T4*; colinearity of the gene and the protein it produces.
3. Relationship of the amber suppressor gene in strain CR63 of phage *T4* to serine in the polypeptide chain; the codons for the amber and the related ochre mutants of phage *T4*, worked out by a study of the amino acids inserted in back-mutations and by genetic methods.
4. The mechanism of suppression, studied with synthetic polynucleotides in the cell-free system.
5. The mechanism of protein synthesis: the role of guanosine triphosphate, the binding of soluble and messenger RNA to ribosomes and the action of puromycin.
6. Integration and growth of temperate bacteriophage.
7. Replication of episomes.

PROTEIN CHEMISTRY

1. Complete determination of the primary structure of chymotrypsin; amino acid sequences and disulphide distribution in the two related enzymes chymotrypsin B and elastase.
2. Chemical structure and mechanism of action of the active centres of chymotrypsin and related enzymes.
3. Development and use of the fluorescent technique for the study of amino acid sequences.
4. Structural studies on glyceraldehyde 3-phosphate dehydrogenase; determination of amino acid sequence of the protein monomer derived from pig muscle; comparative studies on glyceraldehyde 3-phosphate dehydrogenases isolated from a variety of different species including yeast, lobster and man; investigations of the nature of the chemical groups at the four active centres responsible for the catalytic activity of the enzyme.
5. Structural studies on alcohol dehydrogenase from yeast and from horse liver and investigation of the nature of the chemical groups responsible for the catalytic activities of the two alcohol dehydrogenases.
6. Complete determination of the amino acid sequence of the protein azurin from *Pseudomonas* and a study of the mode of binding of the copper.
7. Determination of the amino acid sequence around the phosphate-binding group in transglycosylase.
8. Chemical and other structural studies on tobacco rattle virus and related strains.
9. The sequences around the disulphide bridges in γ-globulins and the heterogeneity of the *C*-terminal sequence in the B chains of antibody globulins.
10. Comparative study of glycopeptides from conalbumin and transferin.
11. Amino acid sequence around the sulphydryl groups of myosin.
12. Structure and biological activity of guinea pig and coypu insulin.
13. Histones and their relation to the template activity of nucleoprotein; experiments on the characterization of RNA, synthesized *in vitro*, by a fingerprinting technique.
14. Development of a two-dimensional technique for the fractionation of digests of RNA and DNA, and application of the method to ribosomal RNA and transfer RNA.
15. Purification of transfer RNA by biological and physical methods, determination of its terminal sequences and identification of some minor base components.
16. Significance of formyl-methionine transfer RNA in protein biosynthesis.

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CELL METABOLISM RESEARCH UNIT

University Department of Biochemistry,
South Parks Road, Oxford
(Oxford 59214)

Honorary Director
Professor Sir Hans Krebs, M.D., D.Sc., F.R.C.P., F.R.S.

Scientific staff

M. N. Berry, D.Phil. (*until Aug. 1964*)
K. Burton, Ph.D.
J. T. Y. Chou, D.Phil. (*until Jan. 1964*)
G. R. Eagle, B.A. (*until Aug. 1964*)
J. A. Grunau, Ph.D. (*until Mar. 1964*)
D. E. Hughes, Ph.D. (*until Sept. 1964*)
Miss M. R. Lunt, D.Phil.
E. A. Newsholme, Ph.D.
D. S. Robinson, Ph.D.
D. H. Williamson, B.Sc.
D. Wing, B.Sc.

Other senior staff

L. V. Eggleston, B.Sc.
R. Hems

Visiting and attached workers

G. Bazzano, Ph.D. (*University of Tulane*)
P. L. Berquist, Ph.D. (*University of Auckland*)
J. Borensztajn, M.D. (*University of Brazil*)
Miss E. Galli, Dott.Biol.Sci. (*University of Milan; NATO Research Fellow*)
W. Gevers, M.B., Ch.B. (*Cape Town; Sir Robert Kotze Scholar*)
Miss P. A. Johnson, Ph.D. (*US Air Force Research Assistant*)
Miss R. Koenig, Ph.D. (*Jena University*)
N. J. Kuhn, B.A. (*MRC Scholar*)
G. Massieu, M.D. (*Mexico University*)
O. N. Miller, Ph.D. (*Tulane University*)
Miss L. Raijman, M.D., B.Sc. (*University of Cordoba*)
F. S. Rolleston, B.Sc. (*Queen's University, Kingston, Canada*)
B. D. Ross, M.B., B.Sc. (*University of London*)
B. Smith, B.Sc. (*MRC Scholar*)
M. G. Smith, M.Sc. (*1851 Scholar*)
R. N. Speake, Ph.D. (*ICI Staff*)
C. Streffer, Ph.D. (*Freiburg University*)
Mrs. A. B. Tarcher, Ph.D. (*University of California*)
A. H. Underwood, B.A. (*Wellcome Trust Scholar*)
J. C. Wallace, Ph.D. (*University of Sydney, 1851 Scholar*)
Mrs. P. G. Wallace, Ph.D. (*Monash University, Victoria*)
M. Wilson, Ph.D. (*Wellcome Research Training Fellowship*)

The Unit is concerned with the study of the mechanism and control of metabolic processes. The properties of various enzymes of special importance in this respect are also being investigated.

Summary of research

1. Rate-controlling factors in respiration.
2. Gluconeogenesis.
3. Metabolism of ketone bodies in animal tissues.
4. Biochemistry of bacteriophages.
5. Metabolism of phosphate polymers in bacteria.
6. Structure and function in micro-organisms.
7. Biological effects of ultrasound.
8. Metabolism and function of inner ear tissues.
9. Regulation of blood triglyceride level.
10. Factors affecting clearing factor lipase formation in adipose tissue.
11. Effect of essential fatty acid deficiency on the visual acuity of the rat.
12. Development of techniques:
    (*a*) Degradation methods for determining the structure of DNA.
    (*b*) Ancillary equipment of gas-liquid chromatography.

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BRAIN METABOLISM RESEARCH UNIT

Department of Pharmacology, University Medical School,
Teviot Place, Edinburgh 8
(Newington 1011)

Honorary Director
Professor W. L. M. Perry, O.B.E., M.D., D.Sc., M.R.C.P.E.

Scientific staff

H. M. Adam, M.B. (*honorary*)
G. W. Ashcroft, M.B., D.Obst.R.C.O.G., D.P.M., M.R.C.P.E.
T. B. B. Crawford, Ph.D. (*honorary*)
D. Eccleston, M.B., D.P.M.
F. Knight, M.B., D.A.
I. Laszlo, Dr.Med., Ph.D.
Miss E. J. McDougall, M.B., D.P.M. (*honorary*)
Miss E. E. Robertson, M.B. F.R.C.P.E., D.P.M. (*honorary*)

Visiting and attached workers

H. Guldberg, M.B., B.Sc.
A. Parker-Rhodes, B.Sc.
Miss C. M. Yates, M.Sc.
} (*University of Edinburgh*)

The work of this Unit, which was established in March 1965, is concerned with the metabolism of amino acids and other substances in the brain and tissue fluids of animals and in the tissue fluids of normal and psychotic humans, and with the action of psychotropic drugs on the metabolism.

Summary of research

ANIMAL STUDIES

1. Development of methods for the estimation of indolalkylamines and their precursors and metabolites in tissue extracts to study (*a*) indolalkylamine metabolism in brain after a ' loading ' dose of tryptophan and (*b*) the effect of drugs on this metabolic system in brain, plasma and cerebrospinal fluid.
2. Metabolism of histamine and its relationship to that of other amines in the brain.
3. Distribution of substance P and adenine nucleotides in the central nervous system.
4. Development of methods for the estimation of catecholamines and their precursors and metabolites in tissue extracts.

CLINICAL STUDIES

1. Development of methods for the estimation of indolalkylamines and their precursors and metabolites in tissue fluids to study (*a*) patterns of metabolites in normal individuals; (*b*) changes in metabolism in depressive illness and effects of antidepressant drugs; (*c*) changes occurring in porto-systemic encephalopathy.

METABOLIC REACTIONS RESEARCH UNIT

Biochemistry Department, Imperial College, London S.W.7
(Kensington 5111)

Honorary Director
Professor E. B. Chain, D.Phil., F.R.S.

Scientific staff

D. M. Blond, D.Phil.
Mrs. R. Catanzaro-Quintiliani, Dr.Med.
S. P. R. Rose, Ph.D.
A. Wiseman, Ph.D.

Other senior staff
A. E. Lowe

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The research programme of this Unit is concerned with the study of the mode of action of hormones, in particular insulin, and certain aspects of brain metabolism.

Summary of research

1. Mode of action of insulin:
   (*a*) The fate of ^{14}C-glucosamine and other slowly metabolized hexoses under the influence of insulin in different insulin-sensitive tissues; identification of the phosphorylated intermediates that accumulate.
   (*b*) The fate of ^{14}C-glucosamine in the liver of normal rats and of rats rendered insulin-deficient by treatment with insulin antiserum.
   (*c*) Comparison of the action of insulin and proteolytic enzymes on the pattern of ^{14}C-glucose and ^{14}C-fructose in rat diaphragm and adipose tissue.
   (*d*) The metabolic pattern of ^{14}C-hexoses in the perfused heart in the presence and in the absence of insulin.
2. The action of various nucleotides on the pattern of glucose metabolism in different tissues.
3. Brain metabolism:
   (*a*) Comparative study of metabolic patterns of glucose, fructose, galactose, maltose and glucosamine in rat brain cortex.
   (*b*) Specific role of hexoses in amino acid transport.
   (*c*) Ultracentrifugal fractionation of brain cortex; preparation of neuron-enriched fraction and its biochemical characterization.
4. Instrumentation: adaptation of bidimensional radiochromatogram scanner for direct quantitative evaluation of radioactive spots by computer.

CHEMOTHERAPY RESEARCH UNIT*

Molteno Institute, Downing Street, Cambridge
(Cambridge 50577)

Director
Miss A. Bishop, Sc.D., F.R.S.

Scientific staff
Mrs. E. W. Smart, Ph.D. (*part-time*)

Attached worker
Miss F. C. Wayland, B.Sc. (*MRC Scholar*)

The Unit was studying the biology of protozoa, with special reference to drug resistance, particularly in malaria parasites, and growth requirements of *Entamoeba* in axenic culture.

Summary of research

1. Rate of the development of resistance to the new, repository antimalarial compound cycloguanil pamoate in strains of *Plasmodium gallinaceum* and the relationship between resistance to this compound and resistance to other antimalarial compounds.
2. Effect of serum and related factors on axenic cultures of *Entamoeba invadens*.
3. Development of resistance to proguanil in two mating types of *Tetrahymena pyriformis* and its stability after conjugation.

* The Unit was disbanded in December 1964 on the Director's retirement. Mrs. Smart has transferred to the External Scientific staff (see p. 166), and Miss Bishop herself is now in receipt of a personal grant from the Council (see p. 210).

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EXPERIMENTAL VIRUS RESEARCH UNIT

Institute of Virology, Church Street, Glasgow W.1
(Western 8855)

Honorary Director
Professor M. G. P. Stoker, M.D., F.R.S.E.

Staff

P. Bourgaux, Dr.Med. (*honorarium; until Sept. 1964*)
G. le Bouvier, M.D.
R. Bürk, B.A.
L. V. Crawford, Ph.D.
I. A. Macpherson, Ph.D.
C. H. O'Neill, Ph.D.
J. D. Pitts, Ph.D.
H. Subak-Sharpe, Ph.D.
M. Sussman, Ph.D. (*until Jan. 1964*)
H. V. Thorne, Ph.D.
D. H. Watson, Ph.D. (*until Mar. 1964*)
F. G. Wingfield Digby, Ph.D.

Other senior staff

Mrs. E. Crawford
W. House, F.I.M.L.T.

Visiting and attached workers

H. V. Aposhian, Ph.D. (*Tufts University School of Medicine, Boston, Mass.*)
P. Black, M.D. (*National Institute of Allergy and Infectious Diseases, Bethesda, Maryland*)
Mrs. D. Bourgaux, M.D. (*Université Libre de Bruxelles*)
David Breeze, B.Sc. (*MRC Scholar*)
R. Dulbecco, M.D. (*Royal Society Visiting Professor*)
K. B. Fraser, M.D. (*University of Glasgow*)
M. Fried (*California Institute of Technology*)
Miss M. Gharpure, M.B. (*Indian Government Polio Research Unit, Bombay*)
P. Gill, Ph.D. (*Medical Research Council of Canada Fellowship*)
P. Gomatos, M.D. (*US Public Health Services Fellowship*)
O. Jarrett, B.V.M.S. (*Horse Race Betting Levy Board Scholar*)
A. L. Kisch, M.D. (*US Public Health Service Fellowship*)
W. B. Martin, Ph.D. (*British Empire Cancer Campaign grant-holder*)
Miss Sue-Ann Milliken, B.Sc. (*University of Glasgow*)
L. Montagnier, Dr.Med. (*Institut du Radium, Paris*)
M. A. Thomas, M.D. (*Council of Europe Medical Fellowship*)
D. Warden, B.Sc. (*MRC Scholar*)
J. M. Whalley, B.Sc. (*British Empire Cancer Campaign grant-holder*)

The Unit carries out research on virus structure and function, with particular reference to hereditary changes in animal cells induced by tumour viruses.

Summary of research

1. Mechanism of neoplastic transformation by polyoma, papilloma and SV40 viruses studied in cell culture.
2. Characteristics of the DNA and protein components of polyoma and papilloma group viruses.
3. Characteristics of neoplastic cells induced by viruses compared with those of normal and of spontaneously appearing neoplastic cells.
4. Synthesis of nucleic acid and protein in herpes-infected cells.
5. Genetics of herpes virus.
6. Mutation in a stable diploid cell line.

VIRUS RESEARCH UNIT

Medical Research Council Laboratories, Woodmansterne Road,
Carshalton, Surrey
(Melville 4461)

Director
F. Kingsley Sanders, D.Phil.

Staff

A. T. H. Burness, Ph.D.
P. Faulkner, Ph.D.
M. L. Fenwick, Ph.D.
S. M. McGee-Russell, D.Phil.
A. D. Vizoso, Ph.D.

Other senior staff
F. W. Clothier, A.I.S.T.

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Visiting workers

W. J. Cruickshank, Ph.D. (*Marischal College, Aberdeen*)

B. Rothwell, B.Sc. (*Bristol College of Science and Technology*)

The work of the Unit is concerned with intracellular events following infection by viruses. Suspensions of cells in simple media, where (*a*) virus growth can be initiated simultaneously in a large number of cells, and (*b*) the behaviour of the infected cells can subsequently be investigated by chemical, morphological and virological methods, are being used to elucidate the cellular mechanisms concerned in virus synthesis.

Summary of research

1. Intracellular events during the growth of a cell-destroying virus in mouse ascites tumour cells (kept alive outside the body either in liquid suspension or in agar layers), studied in order to correlate
   (*a*) the time sequence of different phases of virus growth and
   (*b*) the intracellular sites of synthesis of different virus components with biochemical and morphological alterations of infected cells.
2. Mode of interaction between infective virus nucleic acid and cells showing the early intracellular events following invasion by virus.
3. Development of new cell–virus systems for the study of cellular events during the growth of viruses of varying size and pathogenicity containing different sorts of nucleic acid.
4. Studies on ascites tumours from cells transformed *in vitro* by polyoma virus.
5. Investigation of tissue culture techniques for the study of insect viruses.

HUMAN NUTRITION RESEARCH UNIT

Nutrition Building, National Institute for Medical Research,
The Ridgeway, Mill Hill, London N.W.7
(Mill Hill 3378)

Director

Professor B. S. Platt, C.M.G., M.B., Ph.D.

Scientific staff

Miss I. M. Barrett, B.Sc.
L. Chin, B.Sc. (*until Dec. 1964*)
B. H. Doell, M.Sc.
C. R. C. Heard, D.Phil.
Miss B. A. Lacy, M.Sc.
D. J. Naismith, Ph.D.
P. R. Payne, B.Sc.
B. T. Squires, O.B.E., D.M. (*until Mar. 1965*)
M. R. Turner, M.Sc.

Other senior staff

Mrs. S. N. Payne
Miss H. G. Sheppard
R. J. C. Stewart
P. Ward

Visiting and attached workers

H. A. Al-Rabii, D.Sc. (*University of Baghdad*)
M. Bavendi, Phar.D. (*Public Health Department, Tabriz, Iran*)
Miss Y. Chou, B.Sc. (*Commonwealth Scholar, Singapore*)
N. R. H. El-Maraghi, M.B. (*University of Assiut, Egypt*)
W. Frankul, M.Sc. (*University of Baghdad*)
H. R. Gayed, M.B. (*UAR Government grant-holder*)
Mrs. S. R. Gupta, M.B. (*Leverhulme Trust grant-holder*)
P. V. J. Hegarty, M.Sc. (*Evans Medical Ltd. Research student*)
J. Hodgson, Dip.Tech. (*University of Liverpool*)
L. Hryniewiecki, M.D. (*British Council Scholar*)
Miss N. M. Ibrahim, B.Sc. (*Borough Polytechnic, London*)
E. O. Idusogie, B.Sc. (*Nigerian Government grant-holder*)
Miss M. Jacob, M.Sc. (*London School of Hygiene and Tropical Medicine grant-holder*)
Mrs. S. H. Khatun, M.Sc. (*University of Dacca*)
Mrs. A. K. Lebshtein, M.B. (*University of Assiut, Egypt*)
B. Y. Nadkarni, M.Sc. (*Rockefeller Foundation grant-holder*)
Mrs. S. S. Nasser, M.B. (*WHO Fellow*)
R. Orraca-Tetteh, B.Sc. (*Ghanaian Government grant-holder*)
Miss Soemilah Sostroamidjojo, M.D. (*British Council Scholar*)
Mrs. Duangmanee Viseshakul, M.B. (*Children's Hospital, Bangkok*)

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At the London School of Hygiene and Tropical Medicine

W. R. Aykroyd, C.B.E., M.D., Sc.D. Miss M. E. Cameron, B.H.Sc., Dip.Diet.(N.Z.) G. R. Wadsworth, M.D.	*Department of Human Nutrition*
T. P. Eddy, C.B.E., M.R.C.S., D.P.H. Miss N. M. Griffiths, B.H.Sc., Dip. Diet. (N.Z.) Miss A. Nicholson, B.Sc. P. L. Pellett, Ph.D., A.R.I.C. Miss M. S. Prosper, Dip.Dom.Sc. Miss E. F. Wheeler, B.Sc., Dip. Diet. (Lond).	*Nuffield Provincial Hospitals Trust grant-holders*
Mrs. J. Doughty, B.Sc. D. C. Morley, M.D., D.P.H. Miss J. A. S. Ritchie, M.Sc.	*UNICEF grant-holders; fellowship course in food science and applied nutrition*

The main study of the Unit has been the malnutrition of people in colonial territories and other tropical and subtropical countries; this includes the development of methods for the evaluation and quantitative expression of dietary protein requirements and of the dietary protein values of foods as eaten, and the experimental study of various forms of protein malnutrition. The work is being extended to the study of the dietary protein requirements and intake and the nutritional status of selected groups of the population of the United Kingdom, including children and hospital patients; the relevance of some of the changes produced in animals on various diets to the aetiology of certain disorders occurring in the population of the United Kingdom is also being investigated. The work of the Unit continues to be closely associated with that of the Department of Human Nutrition at the London School of Hygiene and Tropical Medicine.

Summary of research

1. The various forms and manifestations of malnutrition, especially the effects in man and animals of low-protein, high-carbohydrate diets:
   (*a*) Interrelationships of dietary and endocrine factors.
   (*b*) Effects on the reproductive system, on the foetus and infant, on the development and function of the mammary gland, on the nervous system, alimentary canal and skin, and on bone growth.
   (*c*) Biochemical changes in tissues, body fluids and secretions, including milk.
   (*d*) Interrelationships of malnutrition and the effects of zymotic disease, including malaria and worm infestations.
   (*e*) Interrelationships of the metabolism of protein with that of other nutrients.
2. Protein requirements and protein value of foods:
   (*a*) Nutritional value of proteins determined by biological and chemical methods in foods, dishes, meals and dietaries.
   (*b*) Dependence of dietary protein value on other factors, including protein : calorie ratio and total caloric intake.
3. Nutritional status in relation to food processing and its effect on the nutritional value of the food:
   (*a*) Technology of food processing in relation to nutritional values of the processed product.
   (*b*) Surveys of hospital diets.
   (*c*) Surveys of nutritional status of children in institutions where dietary intake can be evaluated.

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DUNN NUTRITIONAL LABORATORY

The University, Milton Road, Cambridge
(Cambridge 55444)

Director
E. H. Kodicek, M.D., Ph.D.

*Deputy Director**
T. Moore, Sc.D. (*until Dec. 1964*)

Scientific staff

Miss I. Antonowicz, Ph.D. (*until Jan. 1965*)
M. J. Barnes, Ph.D.
D. E. M. Lawson, Ph.D.
I. M. Sharman, Ph.D., F.R.I.C.
Mrs. K. J. I. Thorne, Ph.D. (*until Oct. 1964*)

Other senior staff

D. R. Ashby
B. J. Constable
A. Ward
P. W. Wilson

Visiting and attached workers

H. A. Blough, Ph.D. (*University of Pennsylvania*)
Miss E. M. Cruickshank, Ph.D. (*MRC grant-holder*)
D. R. Fraser, B.V.Sc. (*University of Sydney*)
T. K. Murray, Ph.D. (*Food and Drug Directorate, Department of National Health and Welfare, Ottawa*)
D. Tillotson, B.A. (*MRC Scholar*)

The Unit is engaged in research on vitamins and other nutrients, including the elucidation of the biochemical and physiological processes underlying their mode of action, the effects of deficiency, and methods for their estimation in living tissues and in natural and processed products.

Summary of research

1. Vitamin C studies in relation to: connective tissue and mucopolysaccharides; effect on collagen and elastin synthesis; carbohydrate and amino acid composition of granulation tissue.
2. Niacytin, the bound nicotinic acid in cereals: elucidation of chemical structure and biochemical pathways.
3. Vitamin A: mode of action, particularly at subcellular levels; effects of deficiency; blood levels in human subjects; significance for farm animals.
4. Vitamin E studies in relation to: human nutrition; haemolysis test; redox dyes; selenium; methods of determination; biological and antioxidative functions; kidney degeneration; cod-liver oil (pro- and anti-vitamin); enzymic destruction.
5. Vitamin D: studies of distribution in animal tissues and subcellular fractions; metabolism of tritiated and ^{14}C-labelled vitamin D_2 and vitamin D_3 in rats and tissues cultivated *in vitro*; effect of vitamin D and parathyroid on absorption of ^{45}Ca; mechanisms affecting calcium homeostasis; effect of vitamin D on viruses; estimation of vitamin D in natural products by gas–liquid chromatography; identification of metabolites of vitamin D.
6. Biosynthesis of bacterial lipids: investigations on isoprenoid compounds, phospholipids, fatty acids.
7. Experimental calcium deficiency: influence on bone structure in the rat; balance between iron, calcium and copper; mineral deficiencies induced by meat diets.

MEDICAL RESEARCH COUNCIL LABORATORIES, GAMBIA

Fajara, Nr. Bathurst, Gambia, West Africa

Director
I. A. McGregor, O.B.E., M.R.C.P., D.T.M. & H.

Scientific staff

D. S. Harling, M.D., M.R.C.P., D.T.M. & H.
Miss E. Topley, M.D.
Miss G. H. Walker, M.B.
Miss H. M. Wilson, M.R.C.S., D.T.M. & H., D.C.H. (*until Sept. 1964*)
Mrs. M. E. Wilson, M.B., D.T.M. & H.

Other senior staff
A. W. M. Cooke (*Administrative Officer*)

* Since Dr. Moore's retirement there has been no post of Deputy Director.

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Visiting workers

W. Z. Billewicz, M.Sc. (*Obstetric Medicine Research Unit*)
K. O. Courtney, M.D. (*Parke Davis Research Laboratories, Ann Arbor, Michigan*)
H. Foy, Ph.D. (*Wellcome Laboratories, Kenya*)
H. C. Goodman (*WHO Expert Committee on Immunology and Parasitic Diseases*)
H. C. Hopps, M.D. (*Armed Forces Institute of Pathology, Washington*)
Professor E. A. Kabat (*University of Columbia*)
Miss A. Kondi, M.D. (*Wellcome Laboratories, Kenya*)
Professor M. Larivière (*Université de Dakar*)
W. H. R. Lumsden, M.B., D.Sc., D.T.M., D.T.H. (*University of Edinburgh*)
Professor R. Masseyeff (*Université de Dakar*)
P. Mattern, Dr.Med. (*Institut Pasteur de Dakar*)
B. A. Newton, Ph.D. (*MRC External Staff*)
Professor P. Satge (*Université de Dakar*)
A. M. Thomson, M.B., B.Sc., D.P.H. (*Obstetric Medicine Research Unit*)
Z. Trnka (*WHO Expert Committee on Immunology and Parasitic Diseases*)
A. Voller, Ph.D. (*London School of Hygiene and Tropical Medicine*)
Professor T. H. Weller, M.D. (*Harvard University*)

The staff of the Laboratories work on problems related to the tropical diseases of the Gambia. Visiting workers carry out their own research programmes and are given laboratory facilities. The Trachoma Research Unit has a permanent field station at the Gambia Laboratories.

Summary of research

1. Effects of repeated parasitic infection on the health of rural communities.
2. Effects of heavy and repeated malarial infections on Gambian infants and young children.
3. Mechanism of malarial immunity.
4. Measurement of communal malarial immunity by immunofluorescence.
5. Determination of the prophylactic efficiency of the long-acting antimalarial drug CI-501.
6. Antigenic specificity of *Plasmodium falciparum* in West and East Africa.
7. Metabolism of serum protein in Gambians.
8. Incidence and aetiology of anaemia in rural African populations.
9. Pattern of illness in Gambian children.
10. Determination of the factors responsible for high rates of mortality in Gambian children.
11. Determination of the pattern of growth of Gambian children.
12. Effect of socio-economic influences on growth and mortality of Gambian children.
13. Incidence, importance and aetiology of seasonal oedematous states in Gambian adults.
14. Incidence and aetiology of cardiac disease in Gambians.
15. Bionomics of mosquitoes of the *Anopheles gambiae* complex.
16. The female reproductive system and the gonotrophic cycle in *A. gambiae*.

TROPICAL METABOLISM RESEARCH UNIT

University of the West Indies, Mona, Kingston, Jamaica

Director

Professor J. C. Waterlow, M.D., M.R.C.P.*

Assistant Director

J. S. Garrow, M.D., Ph.D., M.R.C.P.E.

Scientific staff

G. A. O. Alleyne, M.B., M.R.C.P.
Miss A. Ashworth, Ph.D.
H. V. Chan, M.B.
K. Fletcher, Ph.D.
D. Halliday, B.Sc.
A. E. M. McLean, B.M., Ph.D. (*until Oct. 1963*)
D. I. M. Picou, M.B., Ph.D.
Miss J. M. L. Stephen, Ph.D.*

* Working at St. Mary's Hospital, London W.2.

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Attached workers

Miss P. E. B. Rodgers, M.D., M.R.C.P.E. (*Colonial Research Fellow; jointly with Department of Medicine, UWI*)

M. B. Wilson, Ph.D. (*Colonial Medical Research Student*)

The Unit is investigating problems of normal and abnormal physiology associated with conditions of life in the tropics. At present it is concerned mainly with the clinical and biochemical effects of malnutrition in infants and young children, and particularly with the study of protein metabolism. The Unit collaborates with members of the staff of the Department of Medicine of the University of the West Indies and with the Government of Jamaica in the study of practical nutritional problems.

A small branch of the Unit has been established in London at St. Mary's Hospital Medical School.

Summary of research

STUDIES ON MALNOURISHED INFANTS

1. Biochemical and clinical criteria for the assessment of the severity of protein depletion and for prognosis.
2. Measurement of body composition: development of new methods and application of the mass spectrometer.
3. Renal function and electrolyte disturbances.
4. Protein turnover, studied with ^{35}S- and ^{15}N-labelled amino acids.
5. Absorption and utilization of leaf protein.
6. Protein requirements of infants.

STUDIES ON ADULTS

1. Epidemiological, clinical and immunological characteristics of Jamaican myelopathy.
2. Calorie cost of work in relation to food intake.

EXPERIMENTAL WORK

1. Fatty acid synthesis by liver tissue *in vitro*.
2. Distribution of protein synthesis in protein depletion.
3. Measurement of protein turnover in the rat in relation to dietary conditions.

INFANTILE MALNUTRITION RESEARCH UNIT

Mulago Hospital, Kampala, Uganda

*Officer-in-Charge**

R. G. Whitehead, Ph.D.

Scientific staff

Miss S. G. Cameron, B.A. (*until May 1964*)
P. S. E. G. Harland, M.B.
Mrs. R. H. Harland, M.B.
Mrs. J. E. McCrae, B.Sc. (*until Feb. 1965*)
Miss K. M. MacWilliam, M.B., M.R.C.P.E., D.C.H. (*until Sept. 1964*)
Miss I. H. E. Rutishauser, B.Sc.

Attached worker

H. J. L. Burgess, M.B., D.T.M. & H. (*Ministry of Health, Uganda*)

The Unit studies individual children who have become malnourished, and the relationship of the children to their environment. The Unit is an Associated Institute of Makerere University College, and works closely with the Uganda Government's Nutrition Unit.

* Professor R. F. A. Dean, the director of the Unit, died in December 1964.

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Summary of research

1. Biochemical abnormalities that may be due to malnutrition.
2. Utilization of locally produced foods for the prevention and treatment of nutritional disease.
3. Home environment of the malnourished child and after-effects of an episode of malnutrition.

SOCIAL PSYCHIATRY RESEARCH UNIT

Institute of Psychiatry, Maudsley Hospital, Denmark Hill, London S.E.5
(Rodney 6333)

Honorary Director
Professor Sir Aubrey Lewis, M.D., F.R.C.P.

Scientific staff

G. W. Brown, Ph.D.
P. E. Bryant, Ph.D.
J. E. Cooper, B.M., M.R.C.P., D.P.M.*
Mrs. B. M. F. Hermelin, Ph.D.
J. G. Ingham, Ph.D.
R. D. King, B.A., Dip.Criminol. (*until Dec. 1964*)
Miss R. D. S. Lang, B.A.
Miss M. H. Lea, B.A.
J. B. Loudon, B.M., Dip.Anthrop. (*until Sept. 1964*)
N. O'Connor, Ph.D.
Professor K. Rawnsley, M.B., M.R.C.P., D.P.M. (*until Sept. 1964*)
Miss N. V. Raynes, M.A. (*until Dec. 1964*)
M. L. Rutter, M.D., M.R.C.P., D.P.M.
Professor J. Tizard, Ph.D. (*until Sept. 1964*)
P. H. Venables, Ph.D. (*until Sept. 1964*)
J. K. Wing, M.D., Ph.D., D.P.M.
Mrs. L. G. Wing, M.B., D.P.M.
M. M. Wood, B.Sc.
W. Yule, M.A., Dip.Psychol. (*until Dec. 1964*)

Visiting and attached workers

Mrs. J. Gerhold, M.S.W. (*University of Washington*)
D. Greenfeld, B.A. (*Johns Hopkins Hospital, Baltimore*)
Miss L. V. Lockyer, B.A. (*Institute of Psychiatry*)
V. Lotter, B.A. (*Middlesex County Council*)
Miss B. Spain, B.A., Dip.Psychol. (*MRC Scholar*)
Mrs. R. P. W. Wortis, B.A. (*Rutgers University, New Jersey*)

The Unit studies the influence of social factors on the occurrence, continuance and outcome of mental illness and mental subnormality. Special attention is given to the measurement of social abnormalities and to deviations from normal psychological development.

Summary of research

1. (*a*) Psychological disabilities in autistic children.
   (*b*) Prevalence of autism and allied conditions in children aged 8–10 years in Middlesex.
   (*c*) Follow-up study of autistic children seen at Maudsley Hospital.
2. Epidemiology of child maladjustment in Aberdeen (jointly with the Obstetric Medicine Research Unit).

†3. (*a*) Sociological investigation of residential institutions for children.
   (*b*) Psychological study of children and staff in residential institutions.

4. Education and management of severely subnormal children.
5. (*a*) Immediate memory and attention in imbeciles.
   (*b*) Transfer phenomena in imbeciles.
6. (*a*) Assessment of family relationships and estimates of the satisfaction these afford.
   †(*b*) Effects of mental illness in a parent or spouse on the rest of the family.
7. (*a*) Social structure and value systems of a rural population.
   (*b*) Periodic enumeration of a rural and a coal-mining valley by private census (in collaboration with the Pneumoconiosis Research Unit).
   (*c*) Prevalence of psychiatric symptoms and attitudes towards them in a rural population.
   (*d*) Follow-up of neurotic patients after discharge from hospital.
   (*e*) Development of methods of observing subjective symptoms.
   (*f*) Socio-psychiatric studies of the Tristan da Cunha community.

* Joint appointment with the Unit for the Study of Environmental Factors in Mental and Physical Illness (p. 147).

† Supported by the US Association for the Aid of Crippled Children.

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8. (*a*) Impact of different types of community services on discharged schizophrenic patients.
   (*b*) In-patient surveys of mental hospitals with different types of social organization.
*9. (*a*) Cumulative Psychiatric Disease Register based on the population of a London Borough.
   (*b*) Methods of standardizing diagnosis and subclassification of mental illness.
10. (*a*) Psychological and physiological functions in normal persons and chronic schizophrenic patients.
   (*b*) Auditory cross-masking in neurotic patients and normal subjects.

UNIT FOR RESEARCH ON THE EPIDEMIOLOGY OF PSYCHIATRIC ILLNESS

Department of Psychological Medicine,
2 George Square, Edinburgh 8
(Newington 6986)

Honorary Director
Professor G. M. Carstairs, M.D., F.R.C.P.E., D.P.M.

Assistant Director
Professor W. I. N. Kessel, M.D., M.R.C.P., D.P.M.

Scientific staff

W. D. Boyd, M.B., M.R.C.P.E., D.P.M. (*until July 1964*)
Mrs. D. L. Dinwoodie, M.B., D.Obst. R.C.O.G. (*until Aug. 1964; part-time*)
G. A. Foulds, Ph.D.
Mrs. A. Guldberg, M.B. (*until Mar. 1964*)
K. Hope, Ph.D.
P. R. Mayo, B.Sc., D.C.P.
A. Munro, M.B., M.R.C.P.E., D.P.M.
Miss M. E. Whiteley, M.A.

Visiting and attached workers

Professor C. K. Aldrich, M.D. (*University of Chicago*)
Miss C. Hassall, Dip.Soc.Sc. (*Nuffield Provincial Hospitals Trust grant-holder*)
M. G. Jayasundera, M.B., D.P.M. (*Colombo Plan Fellow*)
B. F. Picken, M.D. (*US Public Health Service Fellow*)
Miss S. Wolff, B.M., M.R.C.P., D.P.M., D.C.H. (*Mental Health Research Fund grant-holder*)

The Unit studies sections of the population in which there is a high risk of particular psychiatric illnesses and examines clinical, social and psychological features of illnesses in order to develop aetiological hypotheses. The long-term aim in both instances is to pave the way for preventive action.

Summary of research

1. Social and medical factors contributing to psychological disturbance in students.
2. Clinical, social and ecological factors generating attempts at suicide.
3. Effect of a mental health centre upon the numbers, diagnoses and disposal of psychiatric patients.
4. Ten-year follow-up of neurotic patients identified in general practice.
5. Communication between general practitioner and psychiatrist.
6. Relationship of role behaviour to neurotic illness in pregnant women.
7. Behaviour disorders in children referred for psychiatric treatment.
8. Standardization, on a mental hospital in-patient population, of Symptom-Sign Inventory, Hysteroid Obsessoid Questionnaire and Hostility Battery.
9. Changes in symptoms, attitudes and traits concomitant with clinical change in cases of depression.
10. Hostility patterns of patients in a maximum security hospital.
11. Relationship between ratio of 'psychological' to 'somatic' symptoms and modes of expression of hostility.
12. Interrelation of varied types of personality disorder.
13. Personality assessment of women during and after pregnancy.
14. Significance of secondary diagnosis in mental hospital in-patients.

* Supported by the Ministry of Health.

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NEUROPSYCHIATRIC RESEARCH UNIT

Medical Research Council Laboratories, Woodmansterne Road, Carshalton, Surrey
(Melville 4461)

Clinical Investigation Ward, Greenbank, West Park Hospital, Epsom, Surrey
(Epsom 24771)

Director
D. Richter, Ph.D., M.R.C.P.

Scientific staff

R. Balazs, Dr.Med., Dr.Phil.
J. B. Brierley, M.D., F.C. Path.
B. W. L. Brooksbank, Ph.D.
A. W. Brown, B.Sc.
A. J. Coppen, M.D., D.P.M. (*part-time*)
D. R. Dahl, M.D., Ph.D. (*until Sept. 1964*)
M. K. Gaitonde, Ph.D.
Miss T. L. Julian, M.B.E., M.Sc.
A. G. Malleson, M.B., D.P.M., M.R.C.P.
B. S. Meldrum, M.B., Ph.D.
Mrs. M. Metcalfe, Dip.de Psycol. (*part-time*)
D. M. Shaw, M.B., Ph.D., M.R.C.P.
R. Vrba, Dr.Ing.

Other senior staff
G. W. Morris

Visiting and attached workers

F. Bilodeau, Ph.D. (*McGill University, Montreal; Canadian MRC Research Fellow*)
K. A. C. Elliott, D.Sc., F.R.S.C. (*McGill University, Montreal*)
G. E. Gaull, M.D. (*Children's Hospital Medical Centre, Boston, Mass.; National Institutes of Health Fellow*)
Y. Machiyama, M.B., D.Med.Sc. (*University of Tokyo; British Council Fellow*)
J. G. Nievel, M.D. (*University of Budapest; Riker Fellow*)
T. Tursky, M.D. (*University of Bratislava; WHO Fellow*)

The Unit carries out basic and clinical research on the causes and treatment of mental disorders. A Clinical Investigation Ward has been set up at West Park Hospital, Epsom, for the investigation of patients by special methods not ordinarily available in mental hospitals.

Summary of research

1. Biochemical and biophysical factors related to depressive illness and schizophrenia.
2. Biochemistry of the brain in normal subjects and in mental hospital patients.
3. Metabolic changes associated with maturation and with the functional activity of the brain.
4. Action of drugs and electrical shock treatment on the brain.
5. Anoxic damage to the brain during birth asphyxia and open-heart surgery.
6. Characteristics of evoked electrical responses in the brain.
7. Neurological sequelae of meningoencephalitis.
8. Metabolic factors related to epilepsy.

NEUROPHARMACOLOGY RESEARCH UNIT

Department of Experimental Neuropharmacology, The Medical School, Birmingham 15
(Selly Oak 1642)

Honorary Director
Professor P. B. Bradley, D.Sc.

Scientific staff

B. J. Key, Ph.D. (*honorary*)
A. R. King, Ph.D.
Mrs. M. Nikolova, Dr.Med.
M. I. Phillips, B.Sc.
M. H. T. Roberts, B.Sc.
J. H. Wolstencroft, Ph.D.

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Attached workers

G. L. Avanzino, M.D. (*University of Genoa*) R. J. Stephens, B.Sc. (*MRC Scholar*)
R. I. Porter, B.Sc. (*MRC Scholar*)

The Unit is studying the actions of drugs on the central nervous system with particular reference to the correlation between electrophysiological and behavioural effects and to interactions with sensory stimuli. Investigations are also being carried out on the sites of action of drugs in the brain, particularly in relation to synaptic transmission. The drugs studied are those with known effects on mental function and also substances which may be important as neurohumoral agents.

Summary of research

1. Effects of drugs on sensory generalization and sensory discrimination in animals.
2. Effects of drugs on the inflow and integration of sensory information in the brain.
3. Effects of stimulant and sedative drugs on the performance of animals in problem-solving situations in relation to different intensities of background noise.
4. Effect of electrical stimulation of the brain on the behaviour of animals.
5. Effects of drugs and of electrical stimulation of different parts of the brain on recent memory in primates.
6. Effects of drugs on the activity of single neurones in the brain when applied by iontophoresis.

CLINICAL PSYCHIATRY RESEARCH UNIT

Graylingwell Hospital, Chichester, Sussex
(Chichester 3288)

Director

P. Sainsbury, M.D., M.R.C.P., D.P.M.

Scientific staff

W. R. Costain, M.B., D.P.H., D.P.M.
Miss J. C. Grad, Ph.D.
J. B. Knowles, B.Sc., Dip.Psych.
N. B. Kreitman, M.D., D.P.M.
Mrs. C. A. Purves, M.Sc. (*part-time, honorarium; until Sept. 1964*)
J. C. Shaw, B.Sc.

Other senior staff

J. R. Copping (*until Feb. 1965*)
J. D. Haines
G. C. Ongley

Visiting workers

K. I. Pearce, M.D., L.M.C.C. (*University of Saskatchewan*)
Professor R. B. Sloane, M.D., M.R.C.P. (*Queen's University, Kingston*)

The Unit is concerned with the investigation of clinical problems in psychiatry, and much of its work is carried out in conjunction with the hospital staff. Two main subjects have been selected: (*a*) factors in the social and family environment of psychiatric patients associated with their breakdown and admission to hospital, and (*b*) the neurophysiological mechanisms underlying psychiatric symptoms.

Summary of research

CLINICAL AND SOCIAL STUDIES

1. Evaluation of a community mental health service, to assess factors determining admission to mental hospital, the effects on the family of caring for mentally ill patients, and the outcome after two years.
2. Mental illness in married couples.
3. Therapeutic trials and the problems of their design in psychiatry.

EPIDEMIOLOGY

1. Factors determining referral rates of psychiatric patients.
2. Psychological and somatic illness in a general practice.

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PSYCHOSOMATIC AND NEUROPHYSIOLOGICAL STUDIES

1. Clinical study of chronic hypochondriasis.
2. Verbal and motor activity in mental illness and as personality characteristics.
3. Methods of processing psychophysiological data.
4. Quantitative studies of EEG voltage distribution.
5. Perception, stress and EEG alpha activity.

EXPERIMENTAL PSYCHOLOGY

1. Experimental studies of operant verbal conditioning.
2. Acquiescence and other response distortion to questionnaires.

UNIT FOR RESEARCH ON THE CHEMICAL PATHOLOGY OF MENTAL DISORDERS

Department of Physiology,
The Medical School,
Birmingham 15
(Selly Oak 1301)

Hollymoor Hospital,
Northfield,
Birmingham 31
(Priory 2271)

*Physician-in-Charge**

F. A. Jenner, M.B., Ph.D., D.P.M. (*part-time*)

Scientific staff

R. Barber, Ph.D. (*until Sept. 1964*)
A. A. Boulton, Ph.D.
K. Crowshaw, B.Sc. (*until Oct. 1964*)
Miss M. E. P. Hele, M.B., Ph.D. (*until Sept. 1964*)
R. J. Pollitt, Ph.D.
P. W. Ramwell, Ph.D. (*until Sept. 1964*)
J. G. Salway, B.Sc. (*until Sept. 1964*)
Mrs. E. Trotter, B.Sc.

Other senior staff

L. Grant

Attached workers

P. T. Barth, B.Sc. (*MRC Scholar*)
J. C. Goodwin, B.Sc. (*MRC grant-holder*)
S. M. Hanna, M.B., D.T.C.D.(Alexandria), L.M.S.S.A.(London) (*Hollymoor Hospital, Birmingham*)
Miss L. Humphrey, B.Sc. (*University of Birmingham Research Scholar*)
Miss S. A. Hunter, M.Sc. (*University of Birmingham*)
R. G. McDonald-Gibson, B.Sc. (*MRC Scholar*)
Miss J. E. Shaw, Ph.D. (*MRC Scholar*)
M. Sheridan, M.B., M.R.C.P.E., D.P.M. (*Hollymoor Hospital, Birmingham*)

The aims of this Unit are to investigate possible biochemical and humoral abnormalities in patients with mental disorders, and aspects of chemical physiology which may bear on this problem.

Summary of research

PHARMACOLOGICAL STUDIES

1. Factors affecting the spontaneous and evoked release of non-cholinergic substances from the cerebral cortex.
2. Separation and identification of these and similar pharmacologically active substances from brain extracts.
3. Estimation of antidiuretic hormone in rats anaesthetized by ethanol.

BIOCHEMICAL STUDIES

1. Qualitative and quantitative investigation of urine metabolites.
2. Identification and study of oligonucleotides controlling the rate of *in vitro* reactions involved in protein synthesis.
3. Physico-chemical properties of unknown pharmacologically active substances present in urine.

* Professor I. E. Bush was Honorary Director of the Unit until he relinquished the Chair of Physiology at Birmingham University in September 1964.

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1. Factors producing water retention in periodic psychosis, and the relationship between these changes and the changes in mental state.
2. Physiological and pharmacological investigations using urine and other body fluids from patients and normal subjects.
3. Nitrogen metabolism and balance in changing mental states and the psychological and metabolic consequences of influencing these by steroids and thyroxin.
4. Correlation of EEGs with changes in mental state in patients with periodic psychoses.

STEROID METABOLISM

1. Metabolism *in vitro* of 11-oxygenated steroids, particularly those reactions affecting the biological activity of cortisone analogues.
2. Mode of action of hydrocortisone.

ANALYTICAL METHODS

1. Development of apparatus for the automatic treatment and scanning of paper chromatograms, and the use of such apparatus in the fluorimetric estimation of amino acids, amines etc. and for new colorimetric methods for estimation of steroids.
2. Physico-chemical analysis of solvent systems used for partition chromatography in order to improve the use of this method for the estimation of known substances and in the identification of unknown substances; development of rapid methods of paper partition chromatography.

UNIT FOR THE STUDY OF ENVIRONMENTAL FACTORS IN MENTAL AND PHYSICAL ILLNESS

London School of Economics, Houghton Street, Aldwych, London W.C.2
(Holborn 7686)

Director
J. W. B. Douglas, B.M., B.Sc.

Scientific staff
J. E. Cooper, B.M., M.R.C.P., D.P.M.* Miss J. M. Ross, B.Sc.
Miss A. R. Le V. Lawrence, Ph.D.

Attached workers
D. G. Mulligan, Ph.D. (*Home Office grant-holder*) D. M. Nelson, M.A. (*Science Research Council grant-holder*)

This Unit was set up to study problems on the borderline of medicine and sociology and one of its aims is to promote the co-operation of doctors, sociologists and psychologists in joint research and in the development of new techniques. It will also offer to postgraduate students, whether trained as doctors or sociologists, an opportunity to do research in the field of social medicine.

Summary of research

1. National Survey of Health and Development—a longitudinal study of 5000 children born in March 1946. The following studies are now in progress:
   (*a*) Environmental factors in secondary education (in collaboration with Rothamsted Experimental Station).
   (*b*) Effects of illness and other causes of absence from school on measured ability.
   (*c*) Air pollution and respiratory tract infections (in collaboration with the Air Pollution Research Unit).
   (*d*) Delinquency and maladjustment (supported by grant from the Home Office).
   (*e*) Mental development of prematurely born children.
2. A study of young children who have obsessional or neurotic parents.
3. Early child-rearing patterns in different social classes.
4. Vocational training and technical education (supported by a grant from the Science Research Council).

* Joint appointment with the Social Psychiatry Research Unit (p. 142).

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NEUROENDOCRINOLOGY RESEARCH UNIT

University Department of Human Anatomy, South Parks Road, Oxford
(Oxford 58686)

Honorary Director

Professor G. W. Harris, C.B.E., D.M., Sc.D., F.R.S.

Scientific staff

H. M. Charlton, D.Phil.
D. J. El Kabir, M.B.
D. Exley, D.Phil.
Miss M. Reed. Ph.D.

Visiting and attached workers

R. L. W. Averill, M.Agr.Sci., Ph.D. (*MRC of New Zealand*)
K. Brown-Grant, M.D. (*Royal Society Locke Research Fellow*)
G. Fink, M.B. (*Monash University, Victoria; Nuffield Dominions Demonstrator*)
W. H. Florsheim, Ph.D. (*Veterans' Hospital, California; US Public Health Service Fellow*)
R. J. Gellert, Ph.D. (*University of California; US Public Health Service Fellow*)
R. Nallar, M.D. (*Instituto de Biologia y Medicina Experimental, Buenos Aires; National Research Council of Argentina Fellow*)
Professor M. T. Peng, M.D. (*National Taiwan University; Population Council Fellow*)
D. F. Salaman, B.A. (*MRC Scholar*)
W. N. Adams Smith, M.B. (*New Zealand; Nuffield Dominions Demonstrator*)
W. C. Worthington, M.D. (*Medical College of South Carolina; US Public Health Service Fellow*)

The Unit is concerned with investigations into the anatomical, physiological and behavioural relationships between the central nervous system and the endocrine glands.

Summary of research

1. Effect of hormones on the development and differentiation of the central nervous system in the foetus and newborn animal.
2. Chemical mediators by which the hypothalamus regulates the activities of the anterior pituitary gland.
3. Mode of action of the progestational compounds (including contraceptive steroids) on metabolism and on ovarian function.
4. Estimation of thyrotrophic hormone in blood in man and in the experimental animal.
5. Thyroid–ovarian interrelationships.
6. Neuroendocrine factors in induced ovulation in the immature rat.
7. Endocrine activity in psychiatric patients during different phases of mental illness.
8. Studies on steroid hormones:
   (*a*) Development of methods for the estimation of steroid hormones in neuroendocrine studies.
   (*b*) Study of corticosterone metabolites in urine.
   (*c*) Gas chromatographic analysis of steroids derived from biological material.

APPLIED PSYCHOLOGY RESEARCH UNIT

15 Chaucer Road, Cambridge
(Cambridge 55294)

Director

D. E. Broadbent, Sc.D.

Assistant Directors

R. Conrad, Ph.D.
E. C. Poulton, M.B.

Scientific staff

A. D. Baddeley, Ph.D.
M. J. F. Blake, B.Sc.
I. D. Brown, B.Sc.
A. Carpenter, M.B.
E. G. Chambers, M.A. (*honorarium*)
W. P. Colquhoun, Ph.D.
D. W. J. Corcoran, Ph.D.
H. C. A. Dale, Ph.D.
P. R. Freeman, M.A.
M. Hammerton, Ph.D.
J. A. Leonard, Ph.D. (*until Mar. 1965*)
J. Morton, Ph.D.
P. M. A. Rabbitt, Ph.D.
L. H. Shaffer, Ph.D.
R. T. Wilkinson, Ph.D.
Miss M. M. Woodhead

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Other senior staff

A. Davidson

Mrs. M. H. P. Gregory, M.B. (*part-time*)

Visiting workers

Miss N. S. Anderson, Ph.D. (*University of Maryland; National Science Foundation Fellow*)

M. Brandon, B.A. (*Science Research Council/ NATO grant-holder*)

The purpose of the Unit is to observe and measure human behaviour with the aim of establishing the general principles governing healthy human performance in various environments and types of work. The intention is to find principles which are of general scientific interest, and also of practical value when applied to men working in either industry or the Services. The investigations usually consist of experimental studies of individual human activity.

Summary of research

1. Perception:
   (*a*) Alertness during prolonged visual inspection.
   (*b*) Presentation of technical information.
   (*c*) Effect of context on sensory judgments.
   (*d*) Factors affecting the intelligibility of speech.
2. Thinking:
   (*a*) Information theory.
   (*b*) Subjective probability estimates and location of faults in electronic and other systems.
   (*c*) Human limits in decision taking: speed and load stress in a variety of skilled performances.
   (*d*) Coding of information.
3. Moving:
   (*a*) Transfer of training between control systems.
   (*b*) Effects of orders of control, time lags, and control sensitivity in tracking.
   (*c*) Experiments on car driving performance.
   (*d*) Design of keyboards.
4. Working conditions:
   (*a*) Achievement after lack of sleep.
   (*b*) High-intensity noise effects.
   (*c*) Effects of alcohol.
   (*d*) Length and arrangement of work shifts.
   (*e*) Effects of compressed air.
   (*f*) Effects of heat.
5. Learning:
   (*a*) Factors affecting immediate memory, especially in serial tasks.
   (*b*) Teaching of skills.
   (*c*) Factors affecting verbal learning.
6. Personality:
   Relation of individual differences to skilled performance.
7. Methods:
   (*a*) Methods of assessing degree of confidence in experimental results.
   (*b*) Mathematical models for human performance.
   (*c*) Development of portable apparatus for assessing the deterioration of skill.
   (*d*) Automatic data reduction techniques.

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INDUSTRIAL PSYCHOLOGY RESEARCH UNIT

17 Gordon Square, London W.C.1

(Euston 7939)

Honorary Director

Professor G. C. Drew, M.A.

Honorary Deputy Director

J. W. Whitfield, M.A.

Scientific staff

L. J. Buck, B.Sc.
Mrs. G. C. de la Mare, M.A. (*part-time*)
Mrs. N. Harris, B.Sc.
Mrs. S. Jones, Ph.D.
Miss H. A. Long, B.Sc.
Miss D. Monnington, B.Sc.
R. Sergean, M.A.*
R. D. Shepherd, B.Sc.
J. Walker, Ph.D.
P. C. Wason, Ph.D.
Mrs. A. Zajaczkowska, Ph.D.

Attached workers

Miss E. R. Cornish, B.A. (*Ministry of Education State Student*)
Miss M. A. Hughes, M.A. (*University College London*)
P. N. Johnson Laird, B.A. (*Sully Scholar, University College London*)
Mrs. C. M. Loewenthal, B.Sc. (*MRC Scholar*)
Miss B. Thompson, B.A. (*Birkbeck College, London*)

The aim of the Unit is to study occupational problems of scientific interest. Among these are some which can be studied only by field investigation and others which are amenable to laboratory experiment. Studies are also made to assess the value of the methods used in this type of research.

Summary of research

1. Investigation of industrial motivation and behaviour, with particular emphasis on field studies of individual and social factors affecting behaviour at all occupational levels.
   (*a*) Factors influencing preferred hours of work, e.g. overtime, shift cycles.
   (*b*) Individual differences in adaptation to shift work.
   (*c*) Financial and other incentives.
   (*d*) Personality, motivation and performance under stress.
   (*e*) Specific aspects of industrial behaviour, e.g. absence and attendance, labour turnover, and in particular the relative effects of working and economic conditions upon resignation liability after different lengths of service.
   (*f*) Development and refinement of methodology in field research.
2. Investigation of accidents:
   (*a*) Individual differences in accident behaviour.
   (*b*) Retrospective and prospective diagnosis of causative factors by the study of accident data and normal performance.
   c) Relation between accidents and sensory information, with particular reference to the content of sensory input and its form of presentation.
   (*d*) Evaluation of devices designed to maintain perceptual vigilance.
3. Studies on thinking and the communication of information:
   (*a*) Variables affecting
   (i) the comprehension and (ii) the composition of complex instructions.
   (*b*) Factors affecting the reaction time to negatively expressed sentences.
   (*c*) Transfer between conceptual systems.
   (*d*) Information systems and the relationship of these to problem solving, cognitive tasks and organization in industry.
4. Analysis of skills:
   (*a*) Proprioceptive factors in muscular skill.
   (*b*) Sensory control of skilled movements, especially intermodality and crossed modality problems.
   (*c*) Conceptual skills in classification tasks.
   (*d*) Effects of drugs on skills and individual differences in susceptibility.
   (*e*) Display/control problems in skill.
5. Perception studies:
   (*a*) Geometry of visual space.
   (*b*) Factors influencing efficiency of signs—e.g. road traffic signs.

* On leave of absence until October 1964 at International Labour Office, Geneva.

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UNIT FOR THE EXPERIMENTAL INVESTIGATION OF BEHAVIOUR

Department of Psychology, University College London, Gower Street W.C.1
(Euston 7050)

Honorary Director
Professor G. C. Drew, M.A.

Assistant Director
I. S. Russell, Ph.D.

Scientific staff

Mrs. C. M. Coulouris, B.Sc. (*part-time*)
N. Mrosovsky, Ph.D.*
G. Tonini, Dr.Med. (*until Sept. 1964*)

Attached workers

D. Kleinman, B.Sc. (*DSIR Student*)
K. Oatley, B.A. (*MRC Scholar*)
H. Plotkin, B.Sc. (*University College London*)
R. B. Ross, M.Sc. (*University College London*)
K. Strongman, B.A. (*DSIR Student*)

The Unit is undertaking experimental studies of the neurological correlates of behaviour in animals. These studies are concerned with analysing mechanisms of learning, conditioning and motivation.

Summary of research

1. Use of stimulation, ablation and stereotactic lesions in the cerebral cortex, limbic system and hypothalamus to evaluate the roles of such systems in learning and motivation.
2. Use of spreading cortical depression as a technique of functional ablation combined with 'split-brain' techniques to study the role of the cortex in learning and memory.
3. Effects of drugs, hypothermia and electroshock on conditioned behaviour.

UNIT FOR RESEARCH ON OCCUPATIONAL ASPECTS OF AGEING

Department of Psychology, University of Liverpool,
7 Abercromby Square, Liverpool 7
(Royal 5351)

Honorary Director
Professor L. S. Hearnshaw, M.A.†

Honorary Medical Adviser
Professor A. B. Semple, V.R.D., M.D., D.P.H., Q.H.P.

Honorary Scientific Adviser
D. B. Bromley, Ph.D.‡

Scientific staff

Mrs. S. M. Chown, Ph.D. (*honorarium*)
R. C. Cooper, B.A., Ph.D.
F. I. M. Craik, B.Sc.
Mrs. A. D. M. Davies, B.A.
Mrs. G. R. Hearnshaw, Ph.D. (*part-time*)†
G. H. Jamieson, M.Ed.
Mrs. A. C. Owens, M.B.E., Ph.D. (*part-time*)
R. L. Payne, B.A.
G. S. Tune, Ph.D.
Mrs. A. L. G. Ungerson, B.Sc. (*part-time*)
N. E. Wetherick, B.A. (*until Aug. 1964*)

The Unit is studying psychological changes that accompany ageing, with particular reference to changes considered likely to be of occupational importance. Emphasis is laid on both laboratory and field investigations.

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* On leave of absence for one year from February 1965 in the Department of Psychology, University of Pennsylvania.

† On leave of absence abroad for one year from July 1964.

‡ Dr. D. B. Bromley, who is Lecturer in Psychology at Liverpool University, was acting as director during Professor Hearnshaw's absence.

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Summary of research

1. Adjustment of older workers, with reference to motivation, unemployment and redundancy.
2. Adult learning and the problems of retraining and rehabilitation of older persons.
3. Experimental work on memory, cognition, confidence, perception and attention.
4. Evaluation of measures of ' functional age '.

SOCIAL MEDICINE RESEARCH UNIT

The London Hospital Research Laboratories, Ashfield Street, London E.1
(Stepney Green 5257)

Director
Professor J. N. Morris, D.Sc., F.R.C.P., D.P.H.

Assistant Director
J. A. Heady, Ph.D.

Scientific staff

M. R. Alderson, M.D.
J. S. A. Ashley, M.B., Ch.B.
Mrs. M. Brewis, M.D. (*until Nov. 1963*)
Mrs. M. D. Crawford, M.D. (*part-time*)
P. A. Draper, M.B. (*until Nov. 1964*)
M. J. Gardner, B.Sc., Dip.Math.Stat.
Miss E. M. Goldberg, Dip.S.S. (*part-time; until Jan. 1965*)
J. A. H. Lee, M.D., B.Sc., D.P.H.
T. W. Meade, B.M., M.R.C.P.
D. C. Pattison, M.B., D.Obst.R.C.O.G., D.P.H.
C. M. Phillipson, B.A.
M. J. Power, Dip.S.S.
Miss E. Shoenberg, M.A., M.R.C.S., D.P.M. (*part-time*)
S. Yasin, M.A.

Other senior staff
Miss J. W. Marr, Dip.Diet.

Visiting and attached workers

T. H. D. Arie, B.M., D.P.M. (*London Hospital Medical College*)
J. Cassel, M.B., M.P.H. (*University of North Carolina*)
Miss P. M. Fulton, M.B., M.R.C.P.E., D.P.H. (*Central Middlesex Hospital*)
G. J. L. Hall, M.B. (*West Middlesex Hospital*)
Z. Jaksic, M.D., D.P.H. (*Andrija Stampar School of Public Health, Zagreb; WHO Fellow*)
M. Sarner, M.B., M.R.C.P. (*St. George's Hospital, London*)
Z. Sestak, M.D., Dr.P.H. (*Andrija Stampar School of Public Health, Zagreb; WHO Fellow*)

The Unit investigates the influences that social factors may have upon health and sickness, and the relation of social to other factors. Studies are made of populations and of their environments, and individuals are studied in relation to these.

Summary of research

STUDIES ON CARDIOVASCULAR DISEASE

1. Ischaemic heart disease in relation to nature of work and to other factors, including physique and obesity, blood pressure, blood lipids and family history.
2. Factors affecting obesity, blood pressure and blood lipids in men.
3. Prognosis of ischaemic heart disease in relation to diet (therapeutic trial in collaboration with several hospitals).
4. Relation of cardiovascular disease to the hardness of the water and other local factors in British towns.
5. Elementary epidemiology of ruptured cerebral aneurysm and subarachnoid haemorrhage (in collaboration with St. George's Hospital, London).

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SOCIAL STUDIES

1. Patterns of leisure in middle-aged men.
2. Follow-up in the community of young men discharged from a local mental hospital.
3. Juvenile delinquency in East London.

CURRENT TRENDS IN MORBIDITY AND MORTALITY

1. Ischaemic heart disease and peptic ulcer in physicians and others.
2. Disability in middle-aged men.
3. Mortality and major morbidity in young people.

OPERATIONAL RESEARCH ON THE WORKING OF HEALTH SERVICES

1. Case-fatality in teaching and in non-teaching hospitals; postoperative morbidity and mortality among men with hyperplasia of the prostate admitted to hospitals in the North-East Metropolitan Region: background of the patients, condition on admission and care received.
2. Local and personal variations of prescribing rates in general practice and their relationships with other aspects of the National Health Service (in collaboration with the Department of Pharmacology, London Hospital Medical College, and the Department of Statistics, Rothamsted Experimental Station).

MISCELLANEOUS STUDIES

1. Death rates in British towns in relation to social features.
2. Analysis of the development of leukaemia and of other malignant disease by season of year
3. Methodological studies:
   (*a*) Assessment of individual physical activity apart from work.
   (*b*) Short-cut methods for assessment of individual diets.
   (*c*) Development of food tables for diet surveys.

PSYCHOLINGUISTICS RESEARCH UNIT

Institute of Experimental Psychology, 1 South Parks Road, Oxford
(Oxford 57651)

Honorary Director
Professor R. C. Oldfield, M.A.,

Scientific staff

M. Clowes, Ph.D.
D. Gerver, B.A.
J. C. Marshall, Ph.D.
Mrs. A. M. Treisman, D.Phil, M.A.
Mrs. M. Williams, B.Litt., D.Phil. (*part-time*)
A. Wingfield, M.A.

Visiting and attached workers

Professor G. A. Miller, Ph.D. (*Harvard University*)
P. Twitchell Smith, B.A. (*MRC Scholar*)
M. Treisman, M.B., D.Phil. (*University of Oxford*)

The aim of the unit, which was established in October 1964, is the investigation of psychophysiological processes underlying language and other forms of communication in both normal and pathological conditions.

Summary of research

1. Mechanisms of selective attention and message segregation.
2. Statistical features of speech and language.
   (*a*) Properties of stochastically generated samples.
   (*b*) Changes in statistical features of speech in the presence of noise.
   (*c*) Statistical aspects of dysphasic speech.
3. Psychological processes connected with grammatical, syntactical and semantic aspects of normal and disordered speech.
4. Object-naming processes in normal and brain-injured individuals.
5. Factors affecting control of amount, speed, loudness and articulation of speech.
6. Visual perception of characters and reading:
   (*a*) Computer simulation of perceptual processes.
   (*b*) Automatic character recognition and picture discrimination.
   (*c*) Communication between man and computer.

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STATISTICAL RESEARCH UNIT

University College Hospital Medical School,
115 Gower Street, London W.C.1
(Euston 7651)

Director
W. R. S. Doll, O.B.E., M.D., D.Sc., F.R.C.P.

Scientific staff

J. T. Boyd, M.B., D.P.H.
Miss C. M. Devine, B.Sc.*
A. S. Fairbairn, M.B. (*until Apr. 1964*)
Mrs. P. A. Gregory, M.R.C.S.
I. D. Hill, B.Sc.
J. O. Irwin, Sc.D., D.Sc.† (*adviser in biometric techniques; until Jan. 1964*)
M. J. S. Langman, M.B., M.R.C.P.
W. J. Martin, D.Sc.† (*until May 1964*)
M. C. Pike, Ph.D.
Miss N. J. Seyd, B.Sc.
I. Sutherland, D.Phil.
Miss R. Tall, B.Sc.‡

Visiting workers

J. W. Berg, M.D. (*Memorial Hospital of New York*)
A. Nagy, M.D. (*Institute of Oncology, Budapest; WHO Fellow*)
R. Saracci, M.D. (*General Medical Clinic, University of Pisa; Euratom Commission award-holder*)

The Unit is concerned with the development and application of statistical methods in medicine and in the associated sciences, including research into the epidemiology and aetiology of disease, the promotion and analysis of vital statistics, the design and analysis of therapeutic trials of new drugs and other agents, the design and analysis of field trials of prophylactic agents and the application of mathematical–statistical techniques to the solution of laboratory and epidemiological problems. The investigations listed in the summary of research include not only the individual researches of members of the Unit's staff but also the main items of collaborative work undertaken with other Council units, the Council's committees and other scientific workers.

Summary of research

EPIDEMIOLOGY AND AETIOLOGY OF DISEASE

1. Aetiology of cancer of the lung, with particular reference to smoking, air pollution and industry.
2. Epidemiological features of mortality from leukaemia and from cancer of bone, thyroid, stomach and cervix uteri.
3. Cancer incidence in tropical countries.
4. Comparisons between human and experimental data on carcinogenesis.
5. Effects of smoking on mortality.
6. Mortality of gasworkers.
7. Long-term effects of therapeutic irradiation.
8. Effects of small amounts of absorbed radium.
9. Epidemiology of cardio-respiratory diseases.
10. Atmospheric pollution and respiratory disease.
11. Blood groups and gastro-duodenal diseases.
12. Prevalence of infection with drug-resistant tubercle bacilli.
13. World-wide survey of measles.
14. Sources of emotional disturbance in children.

* Transferred to the Council's external scientific staff in October 1964 for work at the Computer Services Centre.

† Working at the London School of Hygiene and Tropical Medicine, Keppel Street, London W.C.1.

‡ Transferred to the Tuberculosis and Chest Diseases Research Unit in October 1964.

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1. Drugs in respiratory tuberculosis in the United Kingdom and abroad.
2. Treatment of leprosy.
3. Treatment of leukaemia and carcinoma of the bronchus.
4. Radiotherapy under high-pressure oxygen.
5. Treatment of gastric ulcer.
6. Drugs in depressive illness.
7. Analgesics in midwifery.

FIELD TRIALS OF PROPHYLACTIC AGENTS

1. BCG and vole bacillus vaccine in the prevention of tuberculosis in adolescents.
2. BCG vaccine in the prevention of leprosy.
3. Trachoma vaccines.
4. Live virus vaccines for the prevention of influenza.
5. Influenza vaccine for the protection of chronic bronchitics and old persons.
6. Fluoride tooth paste for dental caries.

MISCELLANEOUS STUDIES

1. Problems of railway accidents.
2. Use of enzyme tests in screening for pre-invasive carcinoma of the cervix uteri.
3. Studies of tuberculin sensitivity.
4. Reactions to Kveim antigen in healthy subjects.
5. Drug toxicity in different countries.
6. Thiocyanate metabolism and gastric cancer.

INDUSTRIAL INJURIES AND BURNS RESEARCH UNIT

Birmingham Accident Hospital, Bath Row, Birmingham 15
(Midland 7041)

Director
J. P. Bull, M.D., M.R.C.P.

Scientific staff

G. A. J. Ayliffe, M.D.
Miss S. Baar, F.R.I.C.
Mrs. G. M. Buck, B.Sc.
Mrs. S. A. Carney, Ph.D. (*part-time*)
J. W. L. Davies, Ph.D.
Miss S. P. Farrow, B.Sc.
D. MacG. Jackson, M.D., F.R.C.S. (*part-time*)
R. J. Jones, Ph.D.
J. C. Lawrence, Ph.D.
E. J. L. Lowbury, D.M., F.C.Path.
C. R. Ricketts, D.Sc.

Other senior staff

M. Hall, A.I.M.L.T.
H. A. Lilly, F.I.M.L.T.

Attached worker
Mrs. C. Walton, B.Sc.(Econ.)

The work of the Unit is concerned with the causes, local and general pathology, complications and treatment of accidental injuries, including burns and scalds. The Unit works in close liaison with the staff of the Birmingham Accident Hospital.

Summary of research

1. Types, causes and prevention of common injuries; special study of domestic burns.
2. Studies of the shock stage following burns:
   (*a*) Comparative trials of colloid replacement fluids, correlating changes in red cell and blood volume with clinical signs and mortality.
   (*b*) Role of oral and intravenous saline solutions in the treatment of burns.
3. Re-examination of the specification of clinical dextran; effect of different dextran preparations and other plasma substitutes on plasma volume; preparation of radioactively labelled dextrans; nature of the complexes formed by iron with dextran.

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4. Composition of heparin and protamine in relation to standards of activity.
5. Effect of heat on haemoglobin and on certain red cell enzymes; cation exchange of heated red cells and the effect of metabolic inhibitors and stimulators on this exchange.
6. Changes in serum lipoproteins after burns and other injuries.
7. Plasma protein changes and acid–base balance in patients with burns who do not receive intravenous fluid.
8. Sodium requirements after burns; estimation of biological half-life of ^{22}Na in patients with burns.
9. Skin metabolism in relation to burns and the healing of wounds and grafts:
   (*a*) Effects of thermal damage and therapeutic materials on skin cells.
   (*b*) *In vitro* formation of collagen in skin.
   (*c*) Action of proteolytic enzymes on skin.
   (*d*) Composition, toxicity and antigenicity of extracts from burned skin.
10. Contribution of bacterial infection to the pyrexia, blood changes and other general effects of burns; formation in patients with burns of antibodies to bacteria and other possible antigens in the burn.
11. Experimental infection of burns in mice; assessment of antisera and antibiotics in preventing deaths from infection.
12. Development of methods for identification of bacterial flora in wounds.
13. Epidemiology of infection of burns and wounds, with special reference to the hygiene of operating theatres and to the distribution and characteristics of *Staphylococcus aureus* in different environments.
14. Controlled trials of local chemotherapy and chemoprophylaxis for burns and open wounds; studies of various methods of skin disinfection.

TOXICOLOGY RESEARCH UNIT

Medical Research Council Laboratories, Woodmansterne Road, Carshalton, Surrey
(Melville 4461)

Director
J. M. Barnes, C.B.E., M.B.

Scientific staff

W. N. Aldridge, Ph.D.
T. W. Clarkson, Ph.D.
Miss V. M. Craddock, Ph.D.
Miss J. E. Cremer, B.Sc.
F. De Matteis, Laur.Med.
D. F. Heath, D.Phil.
M. K. Johnson, Ph.D., A.R.I.C.
Miss M. Khairy, Ph.D. (*until Feb. 1965*)
A. E. M. McLean, B.M., Ph.D.
P. N. Magee, M.B., M.C.Path.
L. Magos, Dr.Med.
J. Matthews, Ph.D. (*until Dec. 1964*)
A. R. Mattocks, Ph.D., A.R.I.C.
Miss M. J. Ord (Mrs. Bell) Ph.D. (*part-time*)
V. H. Parker, B.Sc.
M. S. Rose, B.Sc.
Miss R. Schoental, D.Sc.
H. B. Stoner, M.D., B.Sc.
P. F. Swann, M.Sc.
B. Terracini, Laur.Med. (*until Jan. 1964*)
C. J. Threlfall, B.Sc.
S. Villa-Trevino, Dr.Med., Ph.D.

Other senior staff

R. C. Emery
A. R. Henderson
Mrs. J. I. Jenkins, B.Sc.
C. R. Kennedy
D. J. Rive, B.Sc. (*until Jan. 1964*)
B. W. Street, A.I.M.L.T.
K. D. Wilford

Visiting and attached workers

W. H. Butler, M.B. (*University College Hospital, London*)
Miss P. M. Fullerton, D.M., M.R.C.P. (*Institute of Neurology*)
H. P. Witschi, M.D. (*Institute of Forensic Medicine, Berne*)

The aim of the Unit is to learn more about physiological processes by a study of the disturbances produced by both physical and chemical injury. The standard physical injury is tourniquet shock. The toxic substances being studied include: aflatoxin in ground-nut meals, alkyl nitrosamines, beryllium, lead,

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dichlorovinylcysteine, carbon tetrachloride, methyl bromide and iodide, *N*-nitroso-*N*-methylurethane, organo-tin, -lead and -mercury compounds, organophosphates and carbamates (used as insecticides), pyrrolizidine alkaloids and other plant materials.

Summary of research

1. Interrelationship of glucose and amino acid metabolism in rat brain.
2. Examination of the chemical, biochemical and physical properties of substances which uncouple oxidative phosphorylation.
3. Biochemical effects of trialkyl tin and trialkyl lead compounds.
4. Alkylation of cell constituents by alkyl nitrosamines and other agents *in vivo* and its possible relation to cellular injury and carcinogenesis.
5. Adenocarcinoma of stomach produced by *N*-nitroso-*N*-methylurethane; a comparison of the metabolism of this compound with that of *N*-methylurethane.
6. Chronic neurotoxic effects of organophosphorus compounds and the sensitivity of the esterases of the central nervous system of the fowl to these compounds.
7. Mechanism of toxic injury to renal tubules by dichlorovinylcysteine.
8. Effects of esterification on the toxicity of pyrrolizidine alkaloids.
9. Biochemistry of the toxic action of methyl bromide and iodide.
10. Inhibition of enzymes by beryllium.
11. Toxic and diuretic action of mercury compounds.
12. Peripheral nerve injury produced by inorganic lead.
13. Quantitative studies on the reactions of glycolysis, gluconeogenesis and the tricarboxylic acid cycle *in vivo* after physical injury.
14. Fat metabolism after physical injury.
15. Changes in the adenine nucleotides and the RNA and DNA fractions of the liver after physical injury.
16. Role of bacterial products from gut flora in the response to physical injury.
17. Influence of cold acclimation and environment on the effects of physical injury.
18. Observations on the body temperature of patients with multiple injuries.
19. Pathogenic effects of *Clostridium welchii* (with Dr. J. J. Bullen, Rowett Research Institute).
20. Behaviour changes in rats as an early index of poisoning.
21. Influence of diet, drugs and insecticides on toxic liver injury.

ENVIRONMENTAL PHYSIOLOGY RESEARCH UNIT

London School of Hygiene and Tropical Medicine,
Keppel Street, London W.C.1
(Museum 6084)

Director
Professor J. S. Weiner, Ph.D., M.R.C.S.

Scientific staff

C. R. Bell, B.A.
K. J. Collins, D.Phil.
G. W. Crockford, B.Sc.
K. G. Foster, B.Sc.
R. F. Hellon, D.Phil. (*until June 1964*)
Mrs. A. N. Watts, B.Sc.

The investigations of the Unit are concerned with anatomical, physiological and ergonomic problems arising in the working environment.

Summary of research

1. Limits of tolerance for work at high temperatures and humidity, with reference to different patterns of work and posture, and in relation to age and physique.
2. Effects of heavy muscular work and static effort on the peripheral circulation in different environmental conditions.

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3. Relationship of raised body temperature to performance in high temperature environmental conditions.
4. Intense radiant heat in relation to the development of protective clothing.
5. Biochemistry and histochemistry of sweat gland activity in man and animals.
6. Growth and heat tolerance of animals at high temperatures.
7. Role of endocrine glands in heat adaptation.
8. Fluid and electrolyte balance during heat exposure in man.
9. Neurological basis of temperature regulation.
10. *Ad hoc* studies, including:
    (*a*) Limits of working capacity in steel works and other industries in relation to environmental conditions.
    (*b*) Design of seats and other equipment for vehicles, laboratories and offices and for the Services.

PNEUMOCONIOSIS RESEARCH UNIT

Llandough Hospital, Penarth, Glamorgan

(Penarth 58761)

Director

J. C. Gilson, O.B.E., M.B., F.R.C.P.

Scientific staff

J. D. Abernethy, M.B. (*until Sept. 1964*)
D. P. G. Bolton, B.M. (*part-time*)
B. W. B. Chan, M.B., M.R.C.P.E.
W. G. Clarke, M.S.R.
G. W. Cook, M.A.
J. E. Cotes, B.M., M.R.C.P.
Miss M. Elan Jones, M.B. (*until Mar. 1965*)
G. Lakshmipathi, M.D., D.I.H.
Mrs. M. McDermott, B.Sc.
C. B. McKerrow, M.D., M.R.C.P.
T. G. Morris, Ph.D., D.I.C.
P. D. Oldham, M.A.
N. Pearl, M.D.
C. E. Rossiter, M.A.
P. L. Storring, M.B. (*until Sept. 1964*)
V. Timbrell, Ph.D., D.I.C.
J. C. Wagner, M.D.

Other senior staff

N. E. Bevan, B.Sc.
Miss M. M. Collins
G. F. Cory* (*Administrative Officer*)
F. Meade
J. A. Reynolds, A.M.I.R.E.
J. W. Skidmore

Visiting and attached workers

G. M. Green, M.D. (*Harvard University Medical School*)
G. Lakshmipathi, M.D., D.I.H. (*Madras*)
R. Peset, M.D. (*British Council Scholar*)

The Unit is investigating alterations in the structure and function of the lungs, resulting from exposure to specific industrial dusts and general air pollution.

Summary of research

FIELD STUDIES

1. Prospective investigation of byssinosis in the cotton industry.
2. Relation of the type of asbestos dust exposure to lung and other tumours.
3. Surveys of beryllium and foundry workers, and also coal- and ex-coal-workers.
4. A survey of respiratory symptoms and lung function in women and children in relation to a specific source of air pollution.

(These surveys are being made in collaboration with several university departments, technical colleges and local and other authorities, and include international comparative studies.)

CARDIO-PULMONARY FUNCTION

1. Theoretical basis and practical applications of the gas transfer factor in the lung (diffusing capacity).
2. Standardization of methods of measuring lung compliance and their applications in working populations.
3. Comparison of techniques of measuring the ventilation/perfusion ratio in lungs.
4. Development of a portable dry timed-spirometer.
5. Investigation of normal values for indices of lung function and the effects on these of seasonal and other factors.

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* Also at Epidemiological Research Unit (p. 159).

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1. Investigation of the immunology of complicated pneumoconiosis of coal-workers and its relation to rheumatoid arthritis.
2. Standardization of the morphological assessment of chronic non-specific lung disease.
3. Analysis of the relation between content and composition of dust in the lungs to lung pathology and X-ray appearances.
4. Quantitative studies of the deposition and retention of fibrous and other dusts in animals.
5. Carcinogenic action of various types of dusts within the pleural cavity in animals.

PHYSICS AND CHEMISTRY

1. Inhalability of fibrous dusts.
2. Relation of falling speed of respirable particles to size, shape and other factors.
3. Development of physical gas analysers.
4. Methods of recording multiple cardio-respiratory indices during exercise conditions.
5. Gas chromatography for use in studies of respiratory function.

RADIOGRAPHY

Improvement of methods of copying chest radiographs and the supervision of sets of films distributed by ILO.

TREATMENT

Theory of clinical trials and its application to chemotherapy in early chronic bronchitis, complicated pneumoconiosis of coal-workers with and without tuberculosis, and other diseases.

EPIDEMIOLOGICAL RESEARCH UNIT (SOUTH WALES)

4 Richmond Road, Cardiff

(Cardiff 20376)

Honorary Director

Professor A. L. Cochrane, M.B.E., M.B., F.R.C.P., D.P.H.

Honorary Assistant Director

W. E. Miall, M.D.*

Scientific staff

H. Campbell, M.B., F.S.S. (*part-time*)
P. C. Elwood, M.D., D.P.H.
P. A. Graham, F.R.C.S. (*honorarium*)
F. C. Hollows, M.B., F.R.C.S., D.O.
T. Khosla, M.Sc. (*part-time*)
Miss J. B. Landsman, M.B., M.R.C.P.
R. McGuiness, M.B.
J. W. Palmer, B.A., D.P.S.A.

Other senior staff

G. F. Cory† (*Administrative Officer; part-time*)

The Unit is developing epidemiological techniques for the study of the prevalence, attack rates and progression rates of common diseases with the ultimate objective of obtaining clues to aetiology and prevention. The Unit works in close association with the Epidemiological Research Unit in Jamaica and the Social Psychiatry Research Unit.

Summary of research

1. Factors influencing the prevalence, attack rate and progression rate of coal-workers' pneumoconiosis, in particular the more serious form, progressive massive fibrosis.
2. Social factors associated with juvenile delinquency in the Rhondda.
3. Controlled trials of the reformative effects of punishments in schools.
4. Distribution of haemoglobin levels in schoolchildren in Cardiff (with Dr. Stewart Kilpatrick, Cardiff Royal Infirmary, and Dr. W. Powell Phillips, Medical Officer of Health for Cardiff), and general studies in anaemia (with the Medical Unit, Cardiff Royal Infirmary).
5. Factors influencing the prevalence and incidence of glaucoma in communities.

* Also Director of the Epidemiological Research Unit (Jamaica) (p. 160).

† Based at the Pneumoconiosis Research Unit, Llandough Hospital (p. 158).

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6. Factors influencing the prevalence of lens opacities.
7. Development of techniques for keeping a census up to date in a local authority area.
8. Sampling techniques for drawing a random sample of the population for a national survey of anaemia.
9. Epidemiology of dental disorders (with Professor J. Miller, Department of Dentistry, Welsh National School of Medicine).
10. Epidemiology of carcinoma of the cervix in Cardiff (part of a large collaborative study).

EPIDEMIOLOGICAL RESEARCH UNIT (JAMAICA)

University of the West Indies, Mona, Kingston 7, Jamaica

Director

W. E. Miall, M.D.*

Scientific staff

M. T. Ashcroft, D.M., D.P.H., D.T.M. & H.
Miss P. Heneage, B.A.
H. G. Lovell, B.A.
H. I. McKenzie, B.Sc.
K. A. Smith, M.B.†
K. L. Standard, M.D., M.P.H. (*honorary; part-time*)

Visiting worker

E. del Campo, M.D. (*University of Santiago; WHO Fellow*)

The Unit has continued a series of long-term epidemiological studies of cardiovascular disease in the general population in Jamaica, and has initiated studies of child growth and development. Survey techniques developed in Britain are being applied to provide comparable data from the Caribbean.

Summary of research

CARDIOVASCULAR RESEARCH

1. Longitudinal study of the influence of environmental and genetic factors on arterial pressure in rural and urban populations in Jamaica and South Wales, with a view to discovering whether differences exist between the two races in the environmental influences determining the rate of rise of arterial pressure with age, in the magnitude of the genetic factor, and in the prognosis of all ranges of arterial pressure.
2. Role of bacteriuria in the aetiology of hypertension in Jamaica and South Wales (with Dr. E. H. Kass, Harvard University Medical School, and Dr. K. L. Stuart, University of the West Indies).
3. Clinical and electrocardiographic studies of the prevalence and attack rates of angina pectoris, myocardial disease, intermittent claudication and cerebrovascular lesions in middle-aged adults.
4. Relationship between fibromyomata of the uterus and hypertension.
5. Influence of the nature of water supplies and other geographical features on mortality from cardiovascular diseases.
6. Role of hypertension and of treponemal infection in the aetiology of aortic disease.
7. Role of yaws and of syphilis in determining positive serological tests for treponemal infection in children in different areas in Jamaica.

STUDIES ON CHILD DEVELOPMENT AND MORTALITY

1. Factors influencing child development in a rural population in Jamaica (studies designed to be parallel to investigations carried out at the Medical Research Council Laboratories in the Gambia and the Obstetric Medicine Research Unit, Aberdeen).
2. Investigations of 10 per cent of all deaths in the island among children aged from 6 months to 3 years to reveal the children at greatest risk and the socio-medical factors involved (in collaboration with the Jamaican Ministry of Health and the Tropical Metabolism Research Unit).
3. Sociological study of the influence of different types of family structure on child development and performance in a rural population.
4. Measurement of heights and weights of schoolchildren in various rural and urban areas of Jamaica to compare rate of growth with that in other countries and to discover any correlations with nutritional status.

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* Also Honorary Assistant Director of the Epidemiological Research Unit (South Wales) (p. 159).

† Seconded from the Ministry of Health, Jamaica.

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In collaboration with the Jamaican Government and the University of the West Indies, the Unit has taken over the responsibility for providing the health service for a rural population of 8000 subjects. It is hoped that this operational research may reveal, by comparisons with other areas, what a more comprehensive type of health service can be expected to achieve in terms of reduced morbidity and mortality, and at what cost, and to indicate possible ways in which the health service can be improved in rural areas in the Caribbean.

AIR POLLUTION RESEARCH UNIT

St. Bartholomew's Hospital Medical College, Charterhouse Square, London E.C.1
(Clerkenwell 1537)

Director
P. J. Lawther, M.B., F.R.C.P.

Scientific staff

B. T. Commins, Ph.D., F.R.I.C.
Mrs. J. Coulson, B.Sc. (*until Aug. 1964*)
J. McK. Ellison, Ph.D.
G. Kazantzis, M.B., Ph.D., F.R.C.S., M.R.C.P.
T. Nash, B.Sc., A.R.I.C.
R. E. Waller, B.Sc.

Other senior staff

B. J. Biles
A. G. F. Brooks

The Unit is concerned primarily with the investigation of the clinical aspects of air pollution as it affects general and industrial populations. Studies are being made on the physical and chemical characteristics of pollutants and on the significance of polluted air, especially in relation to lung cancer and chronic bronchitis.

Summary of research

1. Physical characteristics of particulate pollution; minute structure of particles as shown by the electron microscope; chemical nature of solid, liquid and gaseous air pollutants and the reactions which occur between them, especially during temperature inversions.
2. Development of analytical techniques in determination of pollutants in the extreme dilutions occurring in urban atmospheres.
3. The possible adsorption of sulphur dioxide on particles and its oxidation to sulphuric acid.
4. Determination of carcinogenic substances in town air and in industrial atmospheres.
5. Health hazards of emissions from motor vehicles, with special attention to polycyclic hydrocarbons and carbon monoxide.
6. Effects of pollutants on pulmonary function.
7. Variations in the clinical condition of patients with chronic bronchitis and emphysema in relation to daily changes in weather and air pollution.
8. Clinical trials of smog masks and other protective devices.
9. Clinical study of workers exposed to compounds of mercury and cadmium.
10. Respiratory function in patients with occupational disease of the lungs.
11. Carcinogenic action of certain compounds of cadmium, nickel, arsenic and other metals.
12. Possible hazards associated with the manufacture and application of insecticides.
13. Chemical constitution of irritant and toxic chemicals (including carcinogens) and their mode of action.
14. Use of compounds of minimal toxicity in the protection of living cells against killing by various agents.
15. Investigations of optical methods of assessing particulate pollution and of identifying pollutants.

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CARCINOGENIC SUBSTANCES RESEARCH UNIT

Washington Singer Laboratories, University of Exeter
(Exeter 75817)

Honorary Director
Sir James Cook, D.Sc., F.R.I.C., F.R.S.

Scientific staff

J. M. Barker, Ph.D.
A. Bhati, Ph.D. (*until April 1964*)
W. Carruthers, Ph.D.
I. D. Entwistle, B.Sc.
R. A. W. Johnstone, Ph.D. (*until Nov. 1964*)
H. N. M. Stewart, A.H-W.C., A.R.I.C.
D. A. M. Watkins, Ph.D. (*until Dec. 1963*)

Other senior staff
F. S. Edmunds

The Unit is investigating the chemistry of tobacco and tobacco smoke and of certain high-boiling fractions of petroleum. Direct experimental evidence is being sought for the possible role of cigarette smoke in the causation of lung cancer by chemical analysis of the smoke and identification of any carcinogens which may be present. The chemical constituents of tobacco leaf are also being examined, and the origin of some constituents of the smoke and their mode of formation from substances present in the tobacco leaf are being studied. The work on high-boiling petroleum fractions relates to the carcinogenic activity of some of these materials, and has as its object the isolation and identification of substances responsible for the carcinogenic activity of selected oils.

Summary of research

STUDIES ON TOBACCO SMOKE

1. Chemical investigation of cigarette smoke, and isolation and identification of pure constituents.
2. Mode of formation of certain constituents of cigarette smoke, and relation to components of tobacco leaf.
3. Investigation of constituents of green and cured tobacco leaf.

STUDIES ON MINERAL OILS

1. Chemical examination of carcinogenic fractions distilled from selected crude oils, and isolation and identification of pure constituents.
2. Analysis of mixtures of polycyclic aromatic hydrocarbons by gas-liquid chromatography.

LABORATORY ANIMALS CENTRE

Medical Research Council Laboratories, Woodmansterne Road,
Carshalton, Surrey
(Melville 4461)

Director
J. Bleby, B.Vet.Med. (*from June 1965*)
W. Lane-Petter, M.B. (*until Jan. 1965*)

Scientific staff

Miss A. M. Brown, Ph.D.
Miss M. J. Cook, B.Sc. (*until Sept. 1964*)
Miss M. Dinsley, Ph.D.
Miss T. M. Ellis, B.Pharm.
A. A. Tuffery, M.Sc. (*until June 1964*)

Other senior staff

J. L. Izard
G. Porter, M.Inst.Biol.

Visiting worker
L. Kallai, Dr. Ag. Eng. (*Laboratory Animals Institute, Budapest*)

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The Centre's object is to make more readily available to laboratories animals of a type and quality best suited to their requirements. It has four main functions:—(1) to act as an exchange for information on all problems concerning laboratory animals, and to maintain liaison with comparable organizations in other countries: to this end it prepares news letters, catalogues and other material for distribution to other laboratories, and administers an accreditation scheme for commercial breeders; (2) to maintain, under controlled (pathogen-free) conditions, primary-type colonies of special strains—at present fifteen inbred and three non-inbred strains of mice and one inbred and one non-inbred strain of rats; (3) to conduct relevant research, and (4) to train staff, both graduate and technical.

Summary of research

1. Methods of large-scale production of mice and rats conforming to a given genetic specification and to certain standards of health and nutrition.
2. Control of health in large laboratory populations of high density, especially in conditions of rigorous isolation.
3. Formulation, compounding and assessment of diets for laboratory animals, and methods of sterilizing the food.
4. Assessment of differences in response to various stimuli between different strains of mice (mostly inbred).
5. Anatomy of the mouse.

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External Scientific Staff

The Council appoint to their staff a small number of individual research workers, who are based for the most part in university departments; they are known as the Council's 'External Scientific Staff'.

Birmingham

UNIVERSITY

Chemistry Department

R. G. H. B. BODDY, Ph.D.

Development of microchemical methods for the analysis of dusts causing pneumoconiosis.

Experimental Pathology Department

C. OSORIO, Dr.Med. (*until Sept. 1964*)

1. Turnover of cortisol in patients with the nephrotic syndrome.
2. Development of a method for the preparative fractionation of proteins by starch gel electrophoresis.
3. Preparative fractionation of the Raven preparation of human growth hormone by starch gel electrophoresis.

Experimental Pathology Department and Queen Elizabeth Hospital

J. D. BLAINEY, M.D., M.R.C.P. (*part-time*)

1. Natural history of renal disease investigated by renal biopsy and by prolonged clinical and biochemical studies, with particular reference to the nephrotic syndrome and pyelonephritis.
2. Metabolic studies in acute and chronic renal failure.
3. The applications of haemodialysis.
4. Development of new techniques of haemodialysis and their practical applications.

School of Dental Surgery

S. L. ROWLES, D.Phil. (*until Sept. 1964*)

1. Biochemistry of saliva and dental calculus in animals and man.
2. Chemistry of certain natural and synthetic calcium phosphates.
3. *In vitro* studies on dental plaques.

Cambridge

STRANGEWAYS RESEARCH LABORATORY*

Miss J. M. ALLEN, B.Sc.

1. The host-parasite relationship between cells and bacilli in human leprosy.
2. Response of cells *in vivo* and *in vitro* to murine leprosy bacilli (in collaboration with Dr. R. J. W. Rees, National Institute for Medical Research).
3. Phagocytosis of dead bacteria by fibroblasts in culture.

G. D. CLARKE, Ph.D.

Alterations in metabolism, cytology and malignant potential of rat embryonic fibroblasts after cultivation *in vitro* under conditions of hypoxia or glucose deficiency.

J. T. DINGLE, B.Sc. (see also under J. A. Lucy)

Mrs. S. ADAMS, B.Sc.

1. Lysosomal enzymes of the rat prostate gland *in vivo* and in organ culture.
2. Organ culture experiments on the effect of vitamin A on the synthesis and release of the components of cartilage matrix.

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* The Strangeways Research Laboratory receives a block grant from the Council and further information about its work is given on pp. 182–183. Many of the investigations listed above are carried out in association with the Director or with other staff working at the Laboratory.

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3. Inhibition by ε-amino caproic acid of the breakdown of cartilage matrix in response to excess of vitamin A.
4. Action of hyperoxia on cartilage: resorption of matrix and increased synthesis and release of lysosomal enzymes; inhibition of these effects by cortisol, vitamin E and ε-amino caproic acid.
5. Effect of cortisol on the growth, metabolism and synthetic activity of cartilage in culture.
6. Breakdown of bone and cartilage in response to antisera; the effect of antisera on the synthesis and release of lysosomal enzymes (in collaboration with Dr. R. R. A. Coombs, Department of Pathology, University of Cambridge).
7. Action of excess vitamin A on the structure and metabolism of fibroblasts in culture.
8. Isolation of lysosomal particles from cells in culture.

Miss S. FITTON-JACKSON, Ph.D.

Biosynthetic and other cellular mechanisms in collagen formation.

J. W. DODSON, B.Sc.

Morphogenic interaction of epidermis and dermis.

J. A. LUCY, Ph.D.

1. Formation and stability of macromolecular lipid complexes in aqueous systems.
2. Lipid–protein interactions in aqueous systems.
3. Further development of a theoretical micellar model for the lipids of cell membranes.
4. Effect of fat-soluble vitamins and related compounds on lipoprotein membranes.
5. Vitamin A content of red-cell membranes under various experimental conditions.

D. A. T. NEW, Ph.D.

Effect of cultural conditions on the survival of whole rat embryos in culture.

D. S. O'DELL, Ph.D.

1. Regulation of the synthetic balance between the components of intercellular materials.
2. Preparation and characterization of an antibody to neutral salt-soluble collagen.

M. WEBB, D.Sc.

Miss M. F. P. CAFFREY, B.Sc.

1. Comparative studies on the nature of the respiratory inhibition produced in suspensions of isolated mitochondria by ions of heavy metals and organic derivatives of tervalent arsenic.
2. Action of toxic metals on cellular metabolism and cation balance: kinetic studies on the uptake of metallic ions by bacteria, ascites cells and mitochondria.
3. Alterations in metabolism and cellular composition associated with the development of bacterial strains resistant to the toxic action of heavy metals.
4. Zn^{2+} antagonism of the cytotoxic action of Co^{2+}, Cd^{2+} and Ni^{2+} on rat fibroblasts.
5. Comparative studies on the structure and activities of polysomes from normal rat muscle and from rhabdomyosarcomas induced by intramuscular implantation of cobalt, nickel and cadmium.
6. Comparative studies on the pathways of valine metabolism and leucine biosynthesis in *Aerobacter aerogenes* and *Salmonella typhimurium*.

L. WEISS, M.D., Ph.D.

1. Microruptures of the surface of cells in response to cell movement.
2. Effect of antiserum on the adhesiveness and permeability of cells in culture.
3. Some effects of antisera on the release of lysosomal hydrolases in cell cultures.
4. The possible influence of anti-inflammatory and anti-rheumatic drugs on the response of cells to unheated antiserum.
5. Effect of antisera on mouse bones in late foetal life.

UNIVERSITY

Department of Biochemistry: Sub-department of Chemical Microbiology

R. DAVIES, Ph.D.

1. Stimulation of enzyme formation in yeasts by cyclic dipeptides of arginine and proline.
2. Synthesis of cyclic dipeptides.
3. Action of sulphydryl compounds on yeast cell-wall structures.

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B. A. NEWTON, Ph.D.

1. Protein and nucleic acid metabolism in trypanosomid flagellates.
2. Attempts to establish *in vitro* conditions for the growth of pathogenic trypanosomes.
3. Mode of action of trypanocidal drugs.
4. Mechanisms of drug resistance.

Chemical Laboratory

Mrs. O. KENNARD, M.A., F.Inst.P.

1. Investigation of the structure of natural products by X-ray diffraction methods, with particular reference to steroidal sapogenins and related alkaloids (in collaboration with the Organic Chemistry Division, National Institute for Medical Research); development of computer programs in connection with these investigations.
2. Studies on micrococcin P (in collaboration with the Organic Chemistry Division, National Institute for Medical Research, and the Chemical Crystallography Laboratory, University of Oxford).
3. Experiments on high-accuracy methods of X-ray intensity determinations.
4. Analysis of the crystal structure of acetylcholine seleno-iodide (in collaboration with the Chemical Crystallography Laboratory, University of Oxford).
5. Investigations on the phosphate bond by the analysis of crystal structures of molecules containing high-energy phosphate bonds.
6. Analysis of interatomic distances in published structures and computer refinement of certain published structures with a view to investigating laws governing molecular association (with Professor J. D. Bernal, Birkbeck College, London).

Molteno Institute

H. W. LASER, M.D., Sc.D. (*until April 1964*)
(with grant for assistance)
The biochemical basis of the biological effects of ionizing radiation:

1. Physiological and biochemical changes in organs, yeast, bacteria and enzymic systems which occur during the application of ionizing irradiation.
2. Microbiological studies comprising:
   (*a*) Radiobiological analysis of lysogenic systems.
   (*b*) Mechanism of resistance to both ionizing and ultraviolet radiations in *Micrococcus radiodurans* and some of its spontaneous and X-ray-induced mutants, with particular reference to enzymic repair of lesions in DNA.

MRS. E. W. SMART, Ph.D. (*part-time*)
The axenic cultivation of *Entamoeba invadens*, with particular reference to the effect of serum.

Physiological Laboratory

C. R. AUSTIN, B.V.Sc., D.Sc. (*until Nov. 1964*)

1. Investigation of sperm motility; study of the ultrastructure of spermatozoa and the distribution of enzymes and substrates in these cells.
2. Ultrastructural changes shown by rabbit spermatozoa during their 'capacitation' and during their passage through egg membranes.
3. Comparative survey of gamete morphology and physiology and of fertilization in a variety of non-mammalian organisms.

Psychological Laboratory

W. E. HICK, M.D.

1. Study of skill, with special reference to machine (including vehicle, aircraft etc.) control and supervision, and perceptual problems related to the interpretation of information.
2. Development of usable mathematical (including logical) methods for investigating the above and other psychological problems.
3. Alleged fatigue as a factor in the causation of accidents in aviation and in other modes of transport, and of errors in general.
4. Psychotherapeutic techniques using hallucinogens such as lysergic acid diethylamide and phencyclidine.

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Miss A. W. HEIM, Ph.D.
Miss K. P. WATTS

Development of mental tests and methods of personality assessment:

1. The Self-judging Vocabulary, the Brook Reaction (interests) and the Word-in-context Tests.
2. Two versions of a new high-grade test of adult intelligence (AH 6, AG and SEM).
3. The Shapes Analysis Test: a test of spatial perception devised for potential engineers and architects.
4. Use of these tests in experimental inquiries into such problems as student selection and specialization.

Miss M. A. VINCE, B.A.
Mrs. A. J. WATSON, B.A. (*part-time*)

Development and early behaviour of birds:

1. Relation between physical development, behaviour and environment in nestling great tits.
2. The response of quail embryos to external stimulation as a factor affecting the synchronization of hatching.
3. Temperature requirements of the eggs as a factor in the species-specific behaviour patterns of nest-building and incubation.
4. Effects of age and experience on the learning capacity of bobwhite and painted quail.
5. Manipulation of aggressiveness at different ages in bobwhite flocks.

School of Agriculture

Miss R. DEANESLY, D.Sc.

Reproductive physiology of the female guinea pig:

1. Reactions of the corpus luteum to agents affecting the pituitary.
2. Aspects of ovo-implantation.

Federal Cameroon Republic

KUMBA

Helminthiasis Research Unit

B. O. L. DUKE, O.B.E., M.D., D.T.M. & H.

1. Trials of drugs in the treatment of onchocerciasis, with particular reference to suramin, diethylcarbamazine and Mel W.
2. Prophylactic action of drugs against *Onchocerca volvulus* infection.
3. Experimental infections with *O. volvulus* in chimpanzees.
4. Effect of age, sex, intensity of infections, drug treatment etc. on the transmission potential of the individual.
5. Transmissibility of strains of *O. volvulus* from various topographical and geographical areas by strains of *Simulium damnosum* from other areas.
6. Bionomics of *S. damnosum* in forest areas with special reference to length of adult life, length of larval life, dispersal of adult flies, sources of blood-meals and infective biting density.
7. Control of *S. damnosum* by using DDT as a larvicide on the Sanaga River.

Cirencester

EPIDEMIOLOGICAL RESEARCH UNIT

R. E. HOPE-SIMPSON, O.B.E., M.R.C.S. (*part-time*)

1. Elucidation of the peculiar natural history and symptomatology of the individual viruses causing the common respiratory infections, using a general practice as an unselected population.
2. Participation in a long-term co-operative study of the significance of convulsive disorders in persons under 20 years.
3. Herpes zoster as an example of a latent infection.

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East Grinstead

MCINDOE MEMORIAL RESEARCH UNIT*

D. A. L. DAVIES, D.Sc.

1. Cellular location of transplantation antigens in the mouse.
2. Chemical nature of antigenic determinants of histocompatibility haptens.

A. R. SANDERSON, Ph.D.

1. Measurement of histocompatibility activity by immune cytolysis, using isotope release techniques.
2. Purification of transplantation antigens.

Edinburgh

ROYAL INFIRMARY

Surgical Neurology Department

J. P. LAIDLAW, M.B., M.R.C.P.E. (*part-time*)

Background activity of the human EEG with particular reference to inter- and intra-record variations.

WESTERN GENERAL HOSPITAL

Gastro-Intestinal Unit

W. SIRCUS, M.D., Ph.D., F.R.C.P. (*part-time*)

1. Studies in diseases characterized by malabsorption.
2. Detailed studies in cases of Zollinger–Ellison syndrome.
3. Controlled trials of therapeutic agents for the management of aphthous ulceration.
4. Effect of obstructed gastric emptying on gastric secretion.
5. Controlled studies of carbenoxolone in mouth and duodenal ulceration.

Elstree

LISTER INSTITUTE OF PREVENTIVE MEDICINE

Mrs. J. M. DOLBY, Ph.D.

1. Bactericidal activity of *Bordetella pertussis* antisera:
   (*a*) The inhibition zone.
   (*b*) Varying serum sensitivity of phase I strains.
2. Local and general immunity towards *B. pertussis* in mice infected intracerebrally: an analysis of the mouse test for child-protective antigen.

Miss M. E. MACKAY, Ph.D.

1. Proteolytic enzyme in human plasma.
2. Pharmacologically active substances in human plasma fractions.

Hertford

JOHN INNES INSTITUTE, BAYFORDBURY

Cell Biology Department

J. NEWSOME, M.D., D.T.M. & H.

1. Stimulation of cell division in cultured tissue and blood cells.
2. Phagocytosis of particulate antigens.
3. Establishment of a line of antigen-stimulated cells.

London

BRITISH MUSEUM (NATURAL HISTORY)

D. J. LEWIS, Sc.D.

1. Sand-flies (Phlebotominae) of British Honduras in relation to dermal leishmaniasis.
2. Sand-flies of West Pakistan and the Gambia.
3. The taxonomy and distribution of black-flies (Simuliidae) of Africa, Colombia and Nepal.
4. Man-biting insects of the Cayman Islands.

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* This Unit receives a block grant from the Council: see p. 184.

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CENTRAL PUBLIC HEALTH LABORATORY, COLINDALE

Cross-Infection Reference Laboratory

O. M. LIDWELL, D.Phil.

D. KINGSTON, M.A.

1. Effects on cross-infection, especially with *Staphylococcus aureus*, of the amount of subdivision in hospital ward units of various design.
2. Movements of air and airborne bacteria between the parts of a ward unit and between different ward units.
3. Effects of different ventilation régimes on the airborne bacterial contamination of an operating theatre.
4. Specification of optimum environmental conditions for surgeons when operating and the minimizing of sources of discomfort.
5. Preliminary studies on the cultivation of respiratory syncytial virus with a view to the isolation of this and other respiratory viruses from the air and from other parts of the human environment.

GUY'S HOSPITAL MEDICAL SCHOOL

Chemical Pathology Department

B. MCARDLE, M.D., F.R.C.P., D.C.H.

Miss H. PELS, A.I.S.T. (*technical staff*)

The content, in various neuromuscular disorders, of:

1. Individual phosphatides in cerebrospinal fluid and plasma.
2. Total and individual phosphatides and the total plasmalogen of muscle.
3. RNA and DNA of muscle.

Radioisotopes Laboratory

N. VEALL, B.Sc., F.Inst.P.

J. D. PEARSON, B.Sc.

1. The use of ^{47}Ca for metabolic studies.
2. Measurement of regional cerebral blood flow by ^{133}Xe inhalation and extracranial recording.
3. Studies on peripheral circulation in man using the local tissue clearance of radioisotopes (in collaboration with the Plastic Surgery Centre, Salisbury).

INSTITUTE OF CANCER RESEARCH*

Chester Beatty Research Institute

E. J. DELORME, M.D., F.R.C.S.Can.

1. *In vivo* and *in vitro* studies of anti-tumour activity of immunized lymphoid cells, using syngeneic, allogeneic and heterologous systems.
2. Quantitative inoculation of animal and human tumour cells into conditioned animals to detect presence of specific tumour antigen.

INSTITUTE OF ORTHOPAEDICS, STANMORE

Clinical Research Wing

A. MCPHERSON, M.B., M.R.C.P.

L. JUHÁSZ, Ph.D.

A. W. ZBROZYMA, M.D. (*until February 1964*)

1. Viscerosomatic reflexes.
2. Central nervous control of the bladder.
3. Haemodynamics of bone.
4. Electrical measurement of fibrinolysis.
5. Changes in myoglobin content after nerve cross-union.

Sir Henry Dale Laboratory

J. A. WILKINSON, M.Ch., F.R.C.S. (*part-time*)

1. Genetic factor in the aetiology of congenital dislocation of the hip: family studies.
2. Epiphysial bone growth: effects of experimental shortening and lengthening of the intervening diaphysis.
3. Neonatal surveys for orthopaedic congenital anomalies.

* The Institute of Cancer Research receives a block grant from the Council: see p. 177.

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LEWISHAM HOSPITAL

P. WOLF, M.D.

1. Purification of human AHF protein.
2. Attempt to assay human AHF by an immunological method (with Dr. K. W. Walton, Department of Experimental Pathology, University of Birmingham).
3. Immunochemistry of human platelets.
4. Relationship of free platelet phospholipid in blood to thrombosis.

LONDON HOSPITAL MEDICAL UNIT

F. B. BYROM, M.D., F.R.C.P.

1. Production, mechanism and effects of experimental hypertension.
2. Toxic effects of angiotensin on blood vessels and kidney.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

C. N. DAVIES, D.Sc., F.Inst.P.

1. Production and measurement of aerosols of narrow size range.
2. Human inhalation of aerosol.
3. Specification of the shape of irregular particles.
4. Deposition of aerosol particles from turbulent flow.

M. E. C. GIGLIOLI, Ph.D.

1. The female reproductive system of *Anopheles gambiae melas:* (*a*) the structure and function of the genital ducts and associated organs; (*b*) the ovary.
2. The mangrove swamps of Keneba, lower Gambia river basin:
   (*a*) The climate and the physical composition of the soils (with Mr. I. Thornton, Gambia Department of Agriculture).
   (*b*) pH changes on air-drying swamp soils (with Mr. I. Thornton).
   (*c*) Seasonal variations in the chloride and water content of swamp soils, with observations on the daily levels and the salinity of free soil water during the dry season (with Mr. D. King).
3. A simple recording wind gauge:
   (*a*) Mechanism and method of recording.
   (*b*) Interpreting the recorded wind trace.
4. The breeding of *Anopheles melas* in relation to tides and salinity during the dry season in the Gambia.
5. Age composition of *Anopheles melas* populations collected simultaneously by different methods in the Gambia.
6. The problem of age determination in *Anopheles melas* by Polovodova's method.
7. Oviposition by *Anopheles melas* and its effect on egg survival during the dry season in the Gambia.
8. Some observations on blister beetles (of the family Meloïdae) in the Gambia.

MIDDLESEX HOSPITAL MEDICAL SCHOOL

Institute of Clinical Research

J. COLOVER, M.D., M.R.C.P. (*part-time*)

1. A new method of concentrating small amounts of biological fluids.
2. Changes in the protein fractions in the cerebrospinal fluid in various neurological conditions as revealed by electrophoresis, using one-dimensional and two-dimensional electrophoretic techniques.
3. Comparison of measurement of γ-globulin and other proteins in cerebrospinal fluid in various disease processes, including multiple sclerosis, by different electrophoretic and immunological methods.

NATIONAL HOSPITAL FOR NERVOUS DISEASES

J. A. V. BATES, M.B. (*part-time*)

N. de M. RUDOLF, B.M. (*part-time*)

J. D. COOPER (*technical staff*)

1. Development of physiological criteria for determining the site for stereotactic operations on the human brain.
2. Effect of stereotactic lesions on tremor and rigidity.

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3. Study of Parkinson's syndrome by electromyography.
4. Surgical relief of epilepsy.

A. M. HALLIDAY, M.B., B.Sc.
J. R. PITMAN (*technical staff*)

1. Factors affecting the form of cortical evoked responses in healthy subjects.
2. Changes in cerebral evoked potentials occurring in patients with disorders of sensation or of perceptual awareness and with various lesions of the central nervous system.
3. Development of more versatile methods of recording cerebral action potentials using digital computer techniques.
4. Clinical trial of the therapeutic value of unilateral electro-convulsive therapy in depression and a comparison of its effect on memory with that of conventional bilateral ECT.

P. W. NATHAN, M.D., F.R.C.P.

1. Studies on tracts of the spinal cord in relation to anterolateral cordotomy, rhizotomy and other pain-relieving operations.
2. Spasticity, with special attention to treatment by chemical rhizotomy with phenol solutions.
3. Cerebral lesions and micturition.

Miss M. C. SMITH, M.D., B.Sc., F.C.Path. (*part-time*)

Anatomo-pathological studies, with special reference to nerve-tract degeneration resulting from therapeutic operations, cerebrovascular catastrophes or trauma, and the correlation between the pathological lesion and the clinical state with particular reference to:

1. The central nervous system of patients who have had stereotactic operations for the relief of tremor and rigidity or who have small lesions of the extrapyramidal system due to other causes.
2. The central nervous system of patients who have had anterolateral cordotomies or other pain-relieving operations.

POSTGRADUATE MEDICAL SCHOOL OF LONDON

Chemical Pathology Department

J. S. MCKINLEY-MCKEE, Ph.D. (*until Dec. 1964*)

1. Structure of the active centre in liver and yeast alcohol dehydrogenase and their binary and ternary coenzyme complexes; coenzyme protection and enzymic conformation change.
2. Enzyme complexes and starch gel electrophoresis.
3. Enzyme denaturation and thiol group function in dehydrogenases.
4. Mode of action of mevaldic reductase.
5. Chemistry of acid- and base-catalysed reactions of the nicotinamide coenzymes.

Cyclotron Building (Medical Research Council)

N. B. MYANT, D.M., B.Sc., M.R.C.P.
Mrs. V. J. LANKESTER, B.Sc.
B. LEWIS, M.D., Ph.D., A.R.I.C., M.R.C.P. (*until Feb. 1965*)
K. A. MITROPOULOS, Grad. in Chem. (*National University of Athens*)

1. Regulation of the metabolism of fatty acids and cholesterol, using cell-free mammalian preparations.
2. Disorders of lipid metabolism in humans.
3. Influence of the thyroid on the metabolism of phospholipids of the central nervous system during early stages of development.

ROYAL COLLEGE OF SURGEONS OF ENGLAND

Pharmacology Department

Mrs. H. M. PAYLING WRIGHT, Ph.D., L.M.S.S.A.

1. Histology and reactions of small blood vessels.
2. Effect of lipaemia and added adenosine on platelet adhesiveness.
3. Comparison of platelet adhesiveness and aggregation in pre- and post-operative patients.
4. Effect of splenectomy, with and without anaemia, on platelet behaviour.

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Research Department of Anaesthetics

J. F. NUNN, M.D., Ph.D., F.F.A.R.C.S. (*until July 1964*)

1. Measurement of thermal coefficients of pCO_2 and pO_2 of human blood *in vitro*.
2. Effect of voluntary reduction of lung volume on arterial pO_2 and development of atelectasis.
3. Factors influencing arterial pO_2 in anaesthetized man during artificial ventilation.

Physiology Department

N. AMBACHE, M.A., M.R.C.S.

MRS. J. M. C. WHITING, B.Sc.

1. Intraocular pressure responses to various forms of mechanical irritation in the presence of atropine and mepyramine.
2. Investigation of ' respiratory waves ' in the intraocular pressure of vasodilated eyes.
3. Development of a rapid method for selecting atropinesterase-free rabbits by a mydriatic test and correlation of results with those of manometric methods.
4. Conditions of the release of irin from rabbits' eyes in perfusions of the anterior chamber with various solutions.
5. Experiments on smooth muscle receptors, with particular reference to the effect of some enzymes.

THE ROYAL FREE HOSPITAL AND INSTITUTE OF NEUROLOGY

A. ELITHORN, M.D., M.R.C.P., D.P.M. (*part-time*)
(with grants for assistance)

T. J. BARNETT, B.A.

D. JONES, B.Sc.

Mrs. M. KERR, B.A.(Econ.) (*part-time; until Dec. 1964*)

1. Relationship between perceptual capacity and intellectual capacity.
2. Relationship between anxiety and depression.
3. Computer simulation of human problem solving.

ROYAL HOLLOWAY COLLEGE, ENGLEFIELD GREEN

Zoology Department

W. A. GAUNT, Ph.D.

1. Histochemical patterns during active tooth root formation.
2. Histochemistry of typical and atypical ameloblasts.
3. Comparative study of the structure and development of the dental follicle.
4. Quantitative analyses of the growth of the teeth and jaws.
5. Vascular architecture associated with permanent and deciduous teeth.
6. Innervation of oral and associated tissues.

THE ROYAL INSTITUTION

*Davy Faraday Research Laboratory**

D. W. GREEN, Ph.D.

1. X-ray crystallography determination of the structure of β-lactoglobulin.
2. Studies of reversible conformation changes in proteins in solution.

(In collaboration with Dr. R. Aschaffenburg of the National Institute for Research in Dairying, Sturfield, Reading.)

A. C. T. NORTH, Ph.D., A.Inst.P.

1. Investigation of the structure of lysozyme and other proteins by X-ray diffraction.
2. Explanation of enzymic activity in terms of chain conformation.
3. Development of computational methods for the determination of protein structures.

D. C. PHILLIPS, Ph.D., F.Inst.P.

1. Investigation of the structure and enzymic properties of lysozyme by X-ray diffraction.
2. Development of theoretical and experimental methods of X-ray analysis for the determination of protein structures.
3. Theoretical and computational study of the folding of protein molecules.

* The Laboratory receives a block grant from the Council: see p. 183 for further details of its research projects.

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E. J. M. BOWLBY, M.D., F.R.C.P.

Short-term effects of the temporary loss of a mother-figure.

ST. GEORGE'S HOSPITAL MEDICAL SCHOOL

Department of Medicine

A. ANTONIS, Ph.D., F.R.I.C. (with grant for assistance)

1. Metabolic studies on the dietary control of serum lipoprotein concentration and composition.
2. Epidemiological studies:
   (*a*) Tristan da Cunha Islanders (in collaboration with MRC Study Group).
   (*b*) Bus conductors and drivers and their siblings (in collaboration with Social Medicine Research Unit).
   (*c*) Exposure of rayon workers to CS_2 and H_2S (in collaboration with Social Medicine Research Unit and Department of Remedial Health, London School of Hygiene and Tropical Medicine).
3. Effect of adrenergic compounds on plasma-free fatty acid release in man.
4. Plasma lipase activity under different dietary conditions.
5. Effect of different carbohydrates and catecholamines on ketosis.
6. Methodology:
   (*a*) Automated techniques in serum lipid analysis.
   (*b*) Automated micro-analysis of ketone bodies in serum.

UNIVERSITY COLLEGE

Physiology Department

H. DAVSON, D.Sc.* (with grant for assistance)

C. PURVIS* (*technical staff*)

Local variations in composition of the cerebrospinal fluid; exchange of material between blood, cerebrospinal fluid and brain and cord.

J. W. T. REDFEARN, M.D., D.P.M.

Polarization of the cerebral cortex in the experimental animal (with Dr. O. C. J. Lippold).

UNIVERSITY OF LONDON COMPUTER UNIT

MRC Computer Services Centre, 172 Tottenham Court Road, W.C.1.

B. K. KELLY, M.A.

Miss C. M. DEVINE, B.Sc.

T. J. SCOTT (*technical staff*)

Assistance to the research units and the external staff in the application of computers to their research problems.

WEST HENDON HOSPITAL

Centre for Muscle Substitutes

A. B. KINNIER WILSON, M.B., M.R.C.P., D.P.M.

A. H. BOTTOMLEY, M.B.

R. P. J. G. MCWILLIAM, B.A.

R. E. REILLY, M.Sc.

1. Use of an analogue computer for the analysis of:
   (*a*) Control of powered artificial limbs.
   (*b*) Normal and disordered control of voluntary movement.
   (*c*) Mechanics of obstructed breathing.
2. Development of externally powered muscle substitutes for splints and artificial limbs:
   (*a*) Design of suitable motor units.
   (*b*) Study of control factors involved, using mechanical or myoelectric signals.
   (*c*) Study of various types of transmission systems (splints, artificial arms, harness etc.).

* On leave of absence for one year from October 1963 at the University of Louisville, USA.

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Malaysia

SUNGEI BULOH SETTLEMENT

Research Unit

J. H. S. PETTIT, M.D., M.R.C.P.

J. M. H. PEARSON, B.M., M.R.C.P.

1. Controlled clinical trials:
   (*a*) Lepromatous leprosy: comparison of a group of patients treated with diethyldithioliso-phthalate and diaminodiphenyl sulphone and a group treated with diaminodiphenyl sulphone alone.
   (*b*) Assessment of the value of diaminodiphenyl sulphone at low dosage in the treatment of lepromatous leprosy.
2. Studies on B.663 (a rimino-phenazine derivative):
   (*a*) Pilot trial to assess its value in lepromatous leprosy.
   (*b*) Effect on cases of sulphone-resistant leprosy.
   (*c*) Use in the management of erythema nodosum leprosum.
   (*d*) Use and acceptability as a treatment for tuberculoid leprosy.
   (*e*) Use in the treatment of *Mycobacterium ulcerans* infection.
3. (*a*) Naturally occurring tuberculin and lepromin positivity in Chinese children; methods for converting lepromin negativity to lepromin positivity with BCG and lepromin.
   (*b*) Clinical examination of all family contacts of leprosy patients in an isolated community.
4. Studies on the significance of changes in the morphology of leprosy bacilli, with special reference to:
   (*a*) Morphological changes as a rapid guide to successful treatment.
   (*b*) Detection of drug-resistant disease.
5. Genetic background of patients with leprosy, with special reference to blood groups, colour vision, the salivary secretin factor and glucose-6-phosphate dehydrogenase deficiency.
6. Incidence and type of alopecia in leprosy.
7. Methods of determining circulating sulphone levels and the urinary excretion of sulphone.
8. Clinical search for cases of *Mycobacterium ulcerans* infection.
9. Investigation of tuberculin reactions in leprosy cases with special studies on patients who show an abnormal response.

Manchester

PATERSON LABORATORIES, CHRISTIE HOSPITAL AND HOLT RADIUM INSTITUTE*

Experimental Chemotherapy Department

H. JACKSON, M.B., Ph.D.

1. Effects of alkane sulphonic esters and related compounds on mammalian spermatogenesis and fertility; cumulative actions of mono-esters and di-esters on the proliferating and differentiating stages of germ cell production.
2. Attempts to correlate selective actions on the spermatogenic process with mutagenic and antitumour activities.
3. Metabolism and mode of action of homologous sulphonic esters.
4. Embryopathic effects of certain cytotoxic alkylating compounds, particularly on germ cell development.

UNIVERSITY

Turner Dental School

A. S. HALLSWORTH, Ph.D.

1. Aspects of the molecular biology of collagen relating to dental research.
2. Specific problems associated with the calcification of bone, dentine and enamel.
3. Nature and distribution of fluoride in dental plaque.

Oxford

THE CHURCHILL HOSPITAL

Central Workshop

F. D. STOTT, D.Phil.

E. H. PITTE (*technical staff*)

1. Pulmonary circulation studies with the whole-body plethysmograph (with Dr. G. De J. Lee).
2. Improvements to instruments and methods of diagnosis in cardiovascular disease.
3. Development of instruments for automatic recording of blood pressure (in collaboration with Department of Regius Professor of Medicine).

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* The Paterson Laboratories, Christie Hospital and Holt Radium Institute, receive a block grant from the Council: see p. 182.

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UNIVERSITY

Department of the Regius Professor of Medicine

L. I. WOOLF, Ph.D. (with grant for assistance)
B. L. GOODWIN, D.Phil.
Miss N. G. KENNAWAY, B.Sc.

1. Biochemical genetics, diagnosis and treatment of phenylketonuria.
2. Defects in the metabolism of tyrosine and tryptophan.
3. Renal tubular reabsorption of amino acids and sugars.
4. Chemical investigation of myelination in phenylketonuria and allied disorders.
5. Chemistry of lipidoses and of glycolipids.
6. Metabolism of amino acids, phenolic acids and keto acids in relation to neurological disease.

Sir William Dunn School of Pathology

J. C. F. POOLE, D.M.
N. SMITH, F.I.M.L.T. (*technical staff*)

1. The fine structure of experimental thrombi.
2. Factors influencing platelet agglutination.
3. The effects of hyperlipaemia on cellular changes in fabric grafts on the aorta and in experimental endarterectomy.
4. DNA synthesis in endothelial nuclei.

A. M. WOODIN, Ph.D.
Miss A. A. WIENEKE, D.R.S.

1. Mechanism of secretion of granular material from mammalian cells.
2. Primary cytotoxic effect of leucocidin.
3. Properties of cell surface membranes isolated from leucocytes.

Sheffield

NETHER EDGE HOSPITAL

Rheumatism Research Unit

H. F. WEST, M.D., F.R.C.P., D.T.M.

1. Estimation of corticosteroid hormones and their metabolites in body fluids.
2. Therapeutic trials for rheumatoid arthritis.

UNIVERSITY

Virus Research Laboratory (Lodge Moor Hospital)

R. N. P. SUTTON, D.M., D.C.H.
Studies on rubella virus.

Republic of South Africa

DURBAN, NATAL

Amoebiasis Research Unit, Institute for Parasitology

D. S. BROWN, Ph.D.

1. Taxonomy of the intermediate hosts of *Schistosoma*, and associated freshwater molluscs, in Africa.
2. Distribution of snails of the genera *Bulinus* and *Biomphalaria* in eastern South Africa.

Tanzania

MWANZA

East African Institute for Medical Research

A. D. BERRIE, Ph.D.

1. Bionomics of the snail vectors of *Schistosoma haematobium*.
2. Seasonal variation in transmission of *S. haematobium*.
3. Survey of vector snails in the Mtwara region of Tanzania.
4. Observations on the role of fish-ponds in transmission of *S. haematobium* and *S. mansoni*.

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TANGA

WHO/MRC Bilharziasis Chemotherapy Centre

A. DAVIS, M.B., M.R.C.P.E., D.T.M. & H.

1. Establishment of chemotherapy centre.
2. Comparative clinical trials of antimonial drugs.
3. Evaluation of new oral schistosomicides.

Uganda

MAKERERE UNIVERSITY COLLEGE MEDICAL SCHOOL, KAMPALA

Department of Surgery

D. P. BURKITT, M.D., F.R.C.S.E.

1. The detailed geographical distribution of selected neoplasms in East Africa.
2. Chemotherapy of malignant lymphoma.

Wickford, Essex

RUNWELL HOSPITAL

J. DAWSON, M.B., M.Sc.

1. Influence of alterations in electrolyte and water metabolism on the electroencephalogram in patients with affective disorders and periodic psychoses.
2. Effect of vasopressin and psychotropic drugs on the electrolyte and water metabolism of brain slices.
3. Effect of urinary extracts on the distribution of water, sodium and potassium in brain slices.

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Institutions Assisted by Block Grants

The Council are also able to assist the progress of research through their scheme of block grants. These grants are used to support, in whole or in part, the research activities of a number of autonomous institutions. In addition, individual members of the Council's staff are working in most of these institutions; further details will be found under the appropriate entry in the section of this report entitled 'External Scientific Staff' (p. 164).

INSTITUTE OF CANCER RESEARCH: ROYAL CANCER HOSPITAL*
Fulham Road, London S.W.3

Chairman of the Committee of Management
The Rt Hon. the Earl of Halsbury, F.R.I.C., F.Inst.P.

Secretary
N. P. Hadow, O.B.E., M.A.

CHESTER BEATTY RESEARCH INSTITUTE

Director
Professor A. Haddow, M.D., D.Sc., F.R.S.

Senior scientific staff

P. Alexander, D.Sc., D.I.C.
E. J. Ambrose, D.Sc.
Professor F. Bergel, D.Phil.Nat., D.Sc., F.R.I.C., F.R.S.
Professor E. Boyland, D.Sc.
Professor J. A. V. Butler, D.Sc., F.R.I.C., F.R.S.
R. A. M. Case, M.D., Ph.D.
L. A. Elson, D.Sc., F.R.I.C.
O. G. Fahmy, Ph.D.
L. Foulds, M.D.
R. J. Goldacre, Ph.D.
I. Hieger, D.Sc.
K. S. Kirby, D.Sc.
Professor P. C. Koller, D.Sc.
Miss E. M. F. Roe, Ph.D.
F. J. C. Roe, D.Sc., D.M., M.C.Path.
W. C. J. Ross, D.Sc., F.R.I.C.
G. M. Timmis, D.Sc., F.R.I.C.

PHYSICS DEPARTMENT†

Director
Professor J. W. Boag, D.Sc., F.Inst.P., M.I.E.E., F.S.S. (*from February 1965*)
Professor W. V. Mayneord, C.B.E., D.Sc., F.Inst.P., F.R.S. (*until September 1964*)

Senior scientific staff
N. G. Trott, Ph.D., F.Inst.P.

BIOPHYSICS DEPARTMENT†

Director
Professor L. F. Lamerton, D.Sc., F.Inst.P.

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* The staff of the Institute also includes a number of Recognized Teachers and Senior Lecturers whose names do not appear here.

† On the retirement of Professor Mayneord the Physics Department was divided into the present Departments of Physics and of Biophysics.

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RADIOTHERAPY DEPARTMENT

Director
Professor D. W. Smithers, M.D., F.R.C.P., F.R.C.S., F.F.R.

Senior scientific staff
E. O. Field, D.M., D.M.R.D.

AT THE ROYAL MARSDEN HOSPITAL:

H. J. G. Bloom, M.D., M.R.C.P., F.F.R.
Miss V. M. Dalley, M.B., D.M.R.T.
M. Lederman, M.B., F.F.R.
Mrs. P. Rigby-Jones, M.B., F.F.R.(R.C.S.I.)

CLINICAL RESEARCH DEPARTMENT

(administered jointly with the Royal Marsden Hospital)

Honorary Director
P. E. Thompson Hancock, M.B., F.R.C.P.

Senior scientific staff

D. A. G. Galton, M.D.
Mrs. S. Lawler, M.D.

The Institute was recognized in 1927 as a school of the University of London; since 1951 it has had similar status as an Institute of the British Postgraduate Medical Federation. The work of the Institute is centred in the Chester Beatty Research Institute and in the research activities of the Departments of Physics, Biophysics, Radiotherapy and Clinical Research, which are joint departments of the Institute of Cancer Research and of the Royal Marsden Hospital. Since 1951 the Council has made an annual block grant to the Institute; substantial support is also received from the British Empire Cancer Campaign for Research. Detailed accounts of the Institute's scientific work are available in the Annual Reports of the British Empire Cancer Campaign, and only a brief survey will be given here.

CHESTER BEATTY RESEARCH INSTITUTE

Active work continues in the field of experimental chemotherapy, with special reference to such subjects as the carrier principle in the design of alkylating agents and the role of thiol metabolism in their mechanism of action. Interesting observations have been made with aniline mustard on a murine plasma cell tumour related to human myeloma. The clinical applications of chemotherapy have continued, especially in the treatment of bronchial carcinoma, ovarian adenocarcinoma, gastro-intestinal carcinoma, myelomatosis and the leukaemias.

The main interest of the Chester Beatty Research Institute, however, continues to centre on carcinogenesis. Work has proceeded on the cyclic hydrocarbons, alkylating carcinogens, azo dyestuffs, epoxides, urethane derivatives and metals, amongst other substances. Two trends are emerging: the discovery of an increasing number of agents that appear to operate through alkylation, and the recognition that nucleic acids are involved in the mechanism of action of more carcinogens than had been suspected. In some of these investigations fruitful collaboration has been established with the Sloan-Kettering Institute in New York and with the McArdle Laboratory in Madison, Wisconsin.

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The recent work of the Chester Beatty Research Institute has reflected the current revival in tumour immunology, especially in relation to possible therapeutic effects of the transfer of so-called immune lymphocytes, and to immune responses after autografting under a wide range of experimental conditions.

Other investigations have covered a broad compass, ranging from environmental pathology to cell physiology, and have included studies of the physical and chemical characteristics of the cell surface, the nature of invasiveness, an electro-osmotic theory of protoplasmic movements and the influence on cell division of intense magnetic fields.

There has also arisen a greatly revived interest in cellular differentiation—which is of course fundamental to the cancer problem—and in the extent to which the malignant cell may be capable of chemical redifferentiation. Many investigations in the past have compared various properties of cancer cells with those of the corresponding normal adult cells, but is now seems likely that the cancer cell corresponds more closely to the cells of rapidly growing normal tissue—perhaps that of the embryo or even the trophoblast.

PHYSICS DEPARTMENT

The major research work of the Physics Department (recently divided into Departments of Physics and Biophysics) lies in the fields of radiation, cell proliferation and bioengineering. In all cases the approach is multidisciplinary, involving the physical, biological and medical sciences.

During the past eighteen months the work on radiation has been largely concerned with studies involving small doses of radiation—clinical work in connection with tracer studies in patients and the development of new methods for the measurement of radiation, and experimental studies of the significance of certain types of environmental exposure. Radiation, particularly in the form of continuous exposure, has also been employed in studies of cell proliferation, where the mechanisms of cell population control in normal tissues are being studied and the cell proliferation patterns in normal and malignant tissues compared. A variety of renewal and regenerating tissues in the body are being studied and to an increasing extent these investigations involve studies of the biochemistry of regeneration. In the field of bioengineering, the major projects undertaken during the year have been related to the problems of patient monitoring (including studies of the movement of intestinal contents), ultrasonics and clinical perfusion techniques.

RADIOTHERAPY DEPARTMENT

Long-term clinical studies form the major research activity of the department. These studies have two objects. The first is to build up detailed knowledge of the development, natural history and comparative anatomy of neoplastic disorders. Special attention has been paid to tumours of the upper food passages, the eye and orbit, the testicles and the thyroid. The second object is to assess the value of treatment in a variety of disorders both by irradiation and by other methods, whether used alone or in combination, and the department is conducting or participating in a number of therapeutic trials.

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Another important aspect of the work of this department is the study of the use of isotopes in the investigation and diagnosis of disease. Work on external scanning procedures has included not only studies using intravenously administered isotopes but also investigations using isotopes administered by other routes, for example rectal administration of iodide-131 or bromide-85 for the detection of hepatic metastases. Other investigations have included the development of a new method, combining plethysmography and external counting, of determining radioactivity of the blood without withdrawing samples of blood from the patient. It is hoped that this method will be particularly useful in investigations of abnormalities of the haemopoietic system. In collaboration with the Physics Department fluctuations in tumour radioactivity after the systemic administration of phosphorus-32 have been continuously recorded by small Geiger counters implanted in the tumour; investigations of this type may throw light on hormone dependence and on diurnal changes in the radiosensitivity of tumours.

In the field of radiobiology, studies have been mainly concerned with various aspects of the radiosensitivity of animal tumours. For example, the sensitivities of isolated tumour cells have been determined in tissue culture and compared with the response of the tumour *in vivo*; the influence of irradiation and of thyroid hormones on collagen synthesis and the effect of inhaling high-pressure oxygen on the sensitivity of the whole tumour have also been investigated. The metastatic spread of tumours has been studied on the basis of the viability of tumour cells isolated from patients' blood, by means of labelled nucleic acid and protein precursors. The response of the nervous system to irradiation has been studied in frog nerve muscle preparations, and investigations have proceeded on homologous disease in rats, with emphasis on the mechanism of refractoriness to subsequent challenge with lymphoid tissue.

CLINICAL RESEARCH DEPARTMENT

The clinical research programme is divided into two main sections: (1) investigation into patients' defence mechanisms, their environmental background and the characteristics of their tumours; and (2) studies of new methods of treatment. In all these projects clinical research is closely integrated with the fundamental research at the Institute of Cancer Research.

The investigatory work is mostly incorporated in a project known as the 'Characterization of Human Cancer', in which a series of investigations is carried out by small teams. There is a collection, registration and distribution service which supplies specimens for all purposes. The project includes studies of tumour cell culture (including the inhibitory effect of a range of drugs), the relationship of enzymes and co-enzymes, respiratory behaviour, trace metal content, karyotype, immunological response, level of thiols and disulphides, and tissue and tumour storage. The environmental pathology of the patients from whom the tumours were removed is also investigated.

Special groups of patients are kept under observation, including (1) rubber and cable workers and others known to have been exposed to a carcinogen, (2) women whose cervical smears, taken at routine screening, have shown some abnormal enzyme content (with or without cytological changes), and (3) gas and tar workers.

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Normal women and women with breast tumours and cysts are being studied to see if thermographic scanning of the breasts yields useful information.

Clinical trials of systemic chemotherapy continue to be carried out, with particular reference to the use of alkylating agents in the treatment of myelomatosis and alimentary, pulmonary and ovarian carcinoma, and to hormone therapy in patients with inoperable carcinoma of the kidney. In collaboration with the Royal Veterinary College trials are being made of the effect of cytotoxic drugs in cats and dogs with malignancies similar to those found in humans.

Other studies include attempts to localize the effects of regional chemotherapy by arterial infusion, by improving the delivery of a drug to the tumour site and making it effective only in that region. Work on the treatment of skin tumours with local applications of cytotoxic drugs continues.

ROYAL BEATSON MEMORIAL HOSPITAL

132–138 Hill Street, Glasgow C.3

CANCER RESEARCH DEPARTMENT

Director:
P. R. Peacock, F.R.C.P.G., F.C.Path.

The Cancer Research Department of the Royal Beatson Memorial Hospital has received a block grant from the Council since 1957. It also receives financial support from the British Empire Cancer Campaign. The ordinary maintenance costs of the Department are met by the Western Regional Hospital Board.

The work of the Department includes studies on problems with a clinical bearing as well as investigations of the mechanism of carcinogenesis and aetiological studies.

Recent investigations have included attempts (so far unsuccessful) to induce lung tumours in rats and hamsters by the administration of isoniazid, a compound used in the treatment of human tuberculosis and known to increase the incidence of lung adenoma in mice. Attempts to influence the incidence of lung tumours by exposing mice to various types of atmospheric pollution, including cigarette smoke, intermittent sulphur dioxide and ammonia in subtoxic doses, have also had negative results. Asbestos, however, which is recognized as a cause of fibrosis, mesothelioma and cancer of the lung in man, has been shown to cause fibrotic and neoplastic disease in White Leghorn fowls; but there are histogenetic differences between the two species.

The incidence of tumours of several organs in mice of different genetic make-up has shown that genetic predisposition is not the only factor determining the incidence of neoplasia.

The molecular biology of cell growth and differentiation is being studied by a combination of techniques of biochemistry, tissue culture, optics and electron microscopy.

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CHRISTIE HOSPITAL AND HOLT RADIUM INSTITUTE

Withington, Manchester 20

PATERSON LABORATORIES

Director

L. G. Lajtha, M.D., D.Phil.

During the past eighteen months 32 research scientists and a supporting staff of 70 have been working in the Laboratories. Administrative services are provided by the South Manchester Hospital Management Committee and the Laboratories are under the immediate control of the Cancer Research Scientific Advisory Committee.

The research interest of the Laboratories is strongly slanted towards radiotherapy and is based on two main principles. The first is that progress in the understanding of malignant disease and, eventually, its rational treatment must depend on the furtherance of chemical and biological knowledge of fundamental cellular processes and the effects of radiation on them. To this end the radiation chemistry group has vigorously pursued the study of the immediate effects of radiation on chemical systems of biological interest. The cytogenetic group has analysed the chromosome pattern and behaviour of various mammalian cells, including human cells originating from malignant and other pathological tissue, and genetic studies on the effects of radiation have been continued in mice and *Drosophila*. Studies on cell killing by radiation have been carried out on dormant and dry cells as well as on mammalian tissues *in vivo*. In addition, the effects of low-dose-rate radiation on the survival of human cells in tissue culture have been vigorously investigated, and related to chromosome damage and the growth rate of cell colonies.

The second approach rests on the belief that immediate advances in the techniques of radiotherapy are most likely to come about through close contact between research workers and medical men, and through a deliberate effort by the former to solve problems that arise in the experience of the latter. A device for the extracorporeal irradiation of the circulating blood of leukaemic patients has now been tested and is ready to be applied to suitable cases. Study of the response of monkeys to whole-body irradiation has given much information relevant to the care and management of patients who have been exposed to radiation and of the victims of radiation accidents. The problems confronting the radiotherapist in his attempt to achieve the maximum effect on the tumour while sparing adjacent normal tissue underlie much of the effort that has been made to measure the sensitivity of tissues to radiation, and to study oxygen supply and other factors controlling this sensitivity.

STRANGEWAYS RESEARCH LABORATORY

Wort's Causeway, Cambridge

Director

Dame Honor B. Fell, D.B.E., Sc.D., LL.D., F.R.S. (*Research Professor of the Royal Society*)

Deputy Director

A. Glucksmann, M.D. (*Senior Gibb Fellow, British Empire Cancer Campaign for Research*)

The Laboratory is an independent institution devoted to the study of cell biology. The property is vested in a Board of Trustees, and the management in a Board of five Governors, two of whom are nominated by the Medical

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Research Council. Usually between 30 and 35 graduate scientists, including guest workers, are accommodated.

Recent research has ranged from the study of macromolecular interactions to that of human cancer. The membrane systems of cells, their response to various environmental factors and the fine-structural interrelationship of some of their macromolecular components have been investigated. Particular attention has been paid to the lysosomal system of cells and its associated hydrolases, in relation to its function in the breakdown of bone and cartilage matrix. Mechanisms concerned in the formation of intercellular material and the influence of hormones and vitamins on its synthesis have been investigated and fine-structural changes during myogenesis examined.

Experiments have been made on the nutritional requirements of whole rat embryos in culture and on their response to teratogenic agents. The action of hormones on genital organs in culture has been investigated. Immunological studies have included observations on the resorption of cartilage and bone induced by antisera and on antigenic changes in cell cultures. The physiological effects induced by heavy metals have been studied in bacteria, ascites cells and cell cultures. In the field of microbiology, the role of lysosomes in the reaction of cells *in vivo* and *in vitro* to leprosy bacilli and in the phagocytosis of dead bacilli by fibroblasts, the biosynthesis of leucine in bacteria and the fine structure of radiation-resistant and radiation-sensitive bacteria have been investigated.

Haematological studies have been concerned with the action of testosterone on the bone marrow of children with aplastic anaemia, the biological action of new anti-leukaemic drugs, and the relationship between the reticulum cells of the bone marrow and the immature red and white cells. The effect of radiation on cells in culture and on the developing retina of the rat have been examined. In the field of cancer research, some effects of environment on the malignancy and growth of cells and the action of carcinogens on tissues *in vivo* and in organ culture have been investigated. The influence of hormones on chemical carcinogenesis at various sites is being studied in experimental animals. Long-term clinico-pathological studies on human cancers are relating the biological characteristics of tumours to their response to radiotherapy.

THE ROYAL INSTITUTION OF GREAT BRITAIN

21 Albemarle Street, London W.1

DAVY FARADAY RESEARCH LABORATORY

Director

Sir Lawrence Bragg, O.B.E., F.R.S.

Assistant Director

Professor Ronald King, Ph.D.

Since 1960, the Council have supported, by a means of a block grant, research into the structures of protein molecules at the Davy Faraday Research Laboratory. The Laboratory was set up in 1896 under an endowment by Dr. Ludwig Mond ' to promote by original research the development and extension of chemical and physical science ' and is administered in trust by the Managers of the Royal Institution. It is financed partly by income derived from the original endowment and by donations from industrial organizations. For the last ten years the study of proteins has been a major part of the research

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and this has drawn substantial support from the United States National Institutes of Health in addition to the Council's grant. Three members of the Council's external staff (*see* p.172) have been attached to the laboratory and have played a major part in leading the research, and there has always been close collaboration with the Council's Laboratory of Molecular Biology.

The primary aim of the research programme is the determination of the detailed atomic arrangements in protein molecules and the study of these arrangements in relation to biological function. The structures are being studied by X-ray diffraction methods and a significant contribution from the Laboratory has been the development of new apparatus and techniques, including automatic diffractometers, which have enabled such studies to be carried out more expeditiously.

Work is currently proceeding on the structure of lysozyme, lactoglobulin, rennin and seal myoglobin, and preliminary studies are being made of a number of other proteins. The study of lysozyme has been particularly fruitful, leading to a very clear image of the structure at a resolution of 2 Å, in which the amino acid arrangement can be closely correlated with data on chemical sequence. It has also been possible to locate the position of attachment of certain inhibitor molecules to the lysozyme molecule and further study should throw light on the mechanism of the action of lysozyme on bacterial cell walls.

McINDOE MEMORIAL RESEARCH UNIT

Blond Laboratories, Queen Victoria Hospital, East Grinstead, Sussex

Director

Morten Simonsen, M.D. (*Honorary Professor, Royal College of Surgeons*)

The Unit, which is administered by the East Grinstead Research Trust, receives financial support from several sources, including the Leverhulme Trust as well as the Council. Its work, which is centred on the study of the biological problems of tissue transplantation, is chiefly concerned with two major aspects of this subject. First, the differences between strong and weak histocompatibility antigens are being studied by means of chemical and immuno-genetic investigations. Second, an important part of the work of the Unit is the study of the behaviour of grafted immunologically competent cells in chick embryos and mice. Particular attention is being paid to the study of the dynamics of cell populations during the course of graft-versus-host reactions.

ANTHROPOLOGICAL BLOOD GROUP CENTRE*

Royal Anthropological Institute of Great Britain and Ireland
21 Bedford Square, London W.C.1

Honorary Adviser

A. E. Mourant, D.M., D.Phil., F.R.C.P., M.C.Path.

Statistician-in-charge

Mrs. A. C. Kopec, D.-ès-Sc.

The Centre, which has been supported by a block grant from the Council since 1962, is administered by the Blood Group Committee of the Royal Anthropological Institute of Great Britain and Ireland. Its staff is small and

* Shortly after the period under review the Centre was incorporated in the Council's new serological population genetics laboratory under the direction of Dr. Mourant.

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its main function is to serve as a reference centre, compiling and disseminating data on blood groups for the use of research workers in this country and abroad. Work on a blood group survey of the United Kingdom is almost complete and the results are being prepared for publication. The centre also maintains a unique collection of cross-indexed references to serological population data and serves as co-ordinating centre for population genetical surveys carried out in connection with the International Biological Programme.

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Research Groups

The scheme of research groups has been instituted by the Council to enable them to assist in the development of a research programme in a university department where they regard it as in the national interest to do so. Research groups are established for an agreed period, normally related to the current or next University Grants Committee quinquennium, and are financed by means of a block grant to the university concerned; staff working in research groups are employed by the university. The main prerequisite for the establishment of a group is that the university should undertake to absorb it into its normal structure at the end of the agreed period of tenure.

University of Birmingham

RESEARCH GROUP IN BASIC IMMUNOLOGY

Department of Experimental Pathology, The Medical School,
Birmingham 15
(Selly Oak 1301)

Honorary Director
Professor P. G. H. Gell, M.B.

Staff
Dr. A. S. Kelus, Mgr Phil., Ph.D.

Visiting worker
Stewart Sell, M.D., B.Sc. (*National Institutes of Health, USA*)

The group aims to investigate, on a long-term basis, the molecular and cytological genetics of antigen recognition and antibody formation. The study is continuing of the chemistry and inheritance of allotypes (genetically labelled γ-globulins) in rabbits, together with the relationship of this system to antibody production. This will be used as a model system to elucidate the biochemistry of γ-globulin and of antibody production in the cell.

Summary of research

1. Immunochemical study of allotypic determinants in rabbits.
2. Effects of antigen on normal and sensitized cells; biochemistry of the process of recognition of foreignness.
3. Immunogenetics applied to lower organisms.
4. Phylogeny of immunological functions.

VIRUS RESEARCH GROUP

Department of Virology and Bacteriology, The Medical School,
Birmingham 15
(Selly Oak 1301)

Honorary Director
Professor N. P. L. Wildy, M.B., F.R.S.E.

Staff
W. I. H. Shedden, M.B., B.Sc.
D. H. Watson, Ph.D.

Visiting worker
T. Tetsuka, M. D., Ph.D. (*Tokyo; British Council Fellow*)

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The Group is investigating the multiplication of animal viruses with particular reference to the early phases of infection.

Summary of research

1. Isolation and characterization of the new enzymes and other proteins formed during virus growth.
2. Structure and assembly of herpes virus particles.

University of Edinburgh

EPIGENETICS RESEARCH GROUP

Institute of Animal Genetics, The University, West Mains Road, Edinburgh 9

(Newington 1081)

Honorary Director

Professor C. H. Waddington, C.B.E., Sc.D., F.R.S.

Deputy Director

H. Kacser, Ph.D. (*part-time*)

Staff

M. Birnstiel, Ph.D.
J. A. Burns, B.Sc.
J. G. Campbell, Ph.D.
Mrs. Ruth M. Clayton, M.A. (*honorary*)
R. O. Jones, B.Sc. (*until Oct. 1964*)
Mrs. R. J. Poole, Ph.D.
G. G. Selman, Ph.D. (*honorary*)
D. Truman, Ph.D.

The general aims of the Group are to study the macromolecular, ultrastructural and genetic processes by which embryonic cells develop into the different types found in the adult.

Summary of research

1. Electron microscope investigations of developing cells, particularly in the embryos of *Drosophila* and amphibia.
2. Nuclear–cytoplasmic interactions in *Micrasterias* and *Ochromonas*.
3. Use of antisera, labelled with fluorescent dyes or electron-dense labels, on differentiating cells.
4. Integration of gene-controlled enzymatic pathways into organized networks: theoretical study with an analogue computer and experimental study on certain enzyme systems in *Neurospora*.
5. Synthesis of ribosomal RNA in normal and anucleolar embryos of *Xenopus* and determination of the number of DNA cistrons coding for ribosomal RNA.
6. Sedimentation constants of the RNAs synthesized in different tissues at various stages of early embryonic development in newt and chick embryos.
7. Effects of inhibitors of DNA or RNA synthesis on the development of competence, on the evocation reaction and on short-term differentiation in newt embryos.
8. Statistical mechanics of systems involving feed-back and biological rhythms.

RESEARCH GROUP FOR THE STUDY OF GENETIC PROBLEMS IN ORTHOPAEDIC DISEASES

Department of Orthopaedic Surgery, 12 George Square, Edinburgh 8

(Fountainbridge 2477)

Honorary Director

Professor J. I. P. James, M.S., F.R.C.S.

Staff

Miss R. Wynne-Davies, M.B., F.R.C.S.

187

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The work of this Group is concerned with genetic and other factors in the causation of developmental abnormalities of the locomotor system in man, and with the role of inheritance in orthopaedic disease.

Summary of research

1. Genetics of clubfoot and idiopathic scoliosis.
2. Abnormalities of the skeleton associated with chromosome anomalies (in collaboration with the Clinical Effects of Radiation Research Unit and with Mr. J. Chalmers, Department of Orthopaedic Surgery, University of Edinburgh).

RESEARCH GROUP ON THE ORGANIZATION OF CENTRAL MECHANISMS SUBSERVING VISION

Department of Physiology, University Medical School,
Teviot Place, Edinburgh 8
(Newington 1011)

Honorary Director
Professor D. Whitteridge, D.M., F.R.S.

Honorary staff

J. R. Cronly-Dillon, Ph.D.
J. M. Forrester, M.B.
R. M. Gaze, D.Phil.
M. Jacobson, Ph.D.
M. E. Wilson, M.B.

Attached worker
S. C. Sharma (*Chandigarh Medical Faculty Scholar*)

The aims of the Group are to use information on the mapping of the retina on receptive areas to study the mechanisms by which orderly representation develops. In the adult the main aim is to study the mode of action of the cortex in the analysis and synthesis of visual patterns.

Summary of research

1. Normal pattern and regeneration of optic nerve fibres in the goldfish.
2. Regeneration in compound eyes.
3. Function of area 18 in the visual cortex.
4. Relations between Visual I and Visual II.
5. Behavioural studies on lamination.

RESEARCH GROUP ON THE EXPERIMENTAL AND CLINICAL PROBLEMS OF TRANSPLANTATION

Department of Surgical Science, The University, Edinburgh 8
(Newington 5272)

Honorary Director
Professor M. F. A. Woodruff, M.D., D.Sc., M.S., F.R.C.S.

Staff

N. F. Anderson, M.B.
G. J. A. Clunie, M.B., F.R.C.S. (*honorary*)
J. G. Howard, M.D., Ph.D. (*honorary*)
B. Nolan, M.B., F.R.C.S. (*honorary*)

Visiting and attached workers

H. M. Abaza, M.B., D.Ch. (*Alexandria Medical Research Institute Scholar*)
J. L. Boak, M.B., F.R.C.S.E. (*MRC Junior Fellow*)
E. Evans-Anfom, M.B., F.R.C.S.E. (*Ghana Government Scholar*)
C. J. Inchley, B.Sc. (*MRC Scholar*)
E. S. Lindsey, M.D. (*United States Public Health Service Fellow*)
D. L. Stickel, M.D. (*Duke University, North Carolina*)

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The Group is engaged in clinical and laboratory investigations on tissue transplantation immunity. These include both technical studies of transplantation procedures and fundamental research on the biological processes involved.

Summary of research

1. Use of enzyme-inhibiting drugs in prevention of ischaemic injury to transplanted kidneys.
2. Use of cell suspensions and cellular extracts in production of immune tolerance.
3. Attempts to induce antibody formation *in vitro* by the addition to lymphocytes of RNA fractions prepared from spleens and Kupffer cells of mice injected with *T4* bacteriophage.
4. Evidence for the transformation of lymphocytes into liver macrophages during graft-versus-host reaction.
5. Reticulo-endothelial function during BCG-modified graft-versus-host reaction and the neonatal-thymectomy syndrome.
6. Attempts to initiate immune responses by the transfer of Kupffer cells isolated from mice immunized against bacteriophage.
7. Autoimmune haemolytic anaemia in mice.
8. Use of immunologically competent cells in the treatment of experimental tumours.
9. Clinical study of renal isografts and homografts, including the development of techniques for the prolonged maintenance of a sterile environment.
10. Clinical study of the treatment of advanced cancer by transplantation of immunologically competent cells.

University of London

CEREBRAL FUNCTIONS RESEARCH GROUP

Department of Anatomy, University College London, Gower Street, W.C.1
(Euston 7050)

Director

J. de C. Downer, Ph.D.

Staff

B. G. Cragg, Ph.D.
R. W. Howes, B.Sc.
J. Noble, B.Sc.
Miss J. R. Parriss, B.A. (*until Dec. 1964*)
M. E. Wilson, M.B.

Visiting and attached workers

C. A. Butler, B.Sc. (*MRC Scholar*)
S. Jonas, M.D. (*National Institutes of Health Fellow*)
C. Kupfer, M.D. (*Harvard University Medical School*)
J. P. S. Lumley, M.B. (*University of London*)
Mrs. J. Lund, B.Sc. (*MRC Scholar*)
R. Pigache, M.B. (*Mental Health Research Fund Fellow*)
S. M. Zeki, B.Sc. (*University of London Scholar*)

The basic aim of the Group is the investigation of brain mechanisms involved in sensorimotor integration, learning and memory, and the role of the limbic system in experimentally induced psychopathological states.

Summary of research

1. Role of brain commissures in mediating non-visual crossed tactile placing reactions.
2. Prism-induced errors in visuomotor guidance in the normal and ' split-brain ' monkey.
3. Exploration of the neocortex to localize the area subserving temperature sensibility.
4. Transfer of monocularly learned visual discrimination habits in monkeys following midsagittal division of optic chiasma and following unilateral resection of the visual association areas and the inferior temporal neocortex.
5. Quantitative biochemical changes in the level of DNA, RNA and in DPNH-diaphorase activity of the lateral geniculate nucleus following unilateral optic tract section.
6. Effect of unilateral amygdalectomy on emotional expression in ' split-brain ' monkeys.
7. Differences in memory functions (recognition and recall) following extensive extirpation of the hippocampal complex.

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RESEARCH GROUP ON RENAL INFECTION

Department of Medicine, Charing Cross Hospital Medical School,
Fulham Hospital, London W.6
(Riverside 9161)

Honorary Director
Professor Hugh E. de Wardener, M.B.E., M.D., F.R.C.P.

Staff

Mrs. B. Haswell, B.A., S.R.N.
Miss M. King, S.R.N.
P. J. Little, M.B., M.R.C.P.
Mrs. M. Mookerjee, B.Sc.

The Group is studying the incidence, aetiology, diagnosis and treatment of renal infection.

Summary of research

1. Prevention of pyelonephritis of pregnancy; incidence of prematurity and foetal abnormality in baciliuria of pregnancy.
2. Controlled trial of long- and short-term administration of antibiotics in acute and chronic pyelonephritis.
3. Value of intravenous pyelograms performed with prolonged infusion of hypaque.
4. Intrarenal localization of isotopically labelled antibiotics in isolated perfused kidney.
5. Antibacterial activity of plasma in relation to incidence of pyelonephritis.

RESEARCH GROUP ON RESPIRATION AND ENERGY METABOLISM IN THE NEWBORN

Department of Physiology, The London Hospital Medical College,
Turner Street, London E.1
(Bishopsgate 5454)

Honorary Director
Professor K. W. Cross, M.B., D.Sc., F.R.C.P.

Staff
E. N. Hey, B.M., D. Phil.
Miss J. R. Hill, B.Sc., M.B., D.A.

Attached worker
D. C. Robinson, B.M., M.R.C.P. (*Nuffield Foundation Junior Lecturer in Paediatrics*)

The Group is engaged in studies on the oxygen consumption, ventilation and lung mechanics of the newborn in relation to age, environmental temperature and oxygen pressure. The subjects of the study are normal and sick newborn infants as well as laboratory animals.

Summary of research

1. Minimal oxygen consumption of the normal full-term infant and the premature infant at birth, and the change of the oxygen consumption with age.
2. Thermogenic response of the normal full-term infant and the premature infant to an environment below the critical temperature.
3. Metabolic potential of babies who have suffered cold injury.
4. Oxygen consumption related to environmental temperature in babies of diabetic mothers and babies with the respiratory distress syndrome, anencephaly or other abnormality.
5. Ventilatory response to varying environmental temperatures when the environment of the face is different from that of the body.
6. Asphyxia neonatorum, studied both in the baby and under experimental conditions in animals.

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RESEARCH GROUP ON GLYCOGEN METABOLISM

Royal Free Hospital School of Medicine,
8 Hunter Street, London W.C.1
(Terminus 5385)

Honorary Director
Professor W. J. Whelan, Ph.D., D.Sc., F.R.I.C.

Staff

E. E. Smith, Ph.D.

Mrs. P. M. Taylor, Ph.D.

The Group is studying all pathways of glycogen metabolism lying between glucose, its derivatives and the polymer. Special emphasis is placed on hydrolytic pathways of degradation since these are now recognized to be of major importance. The Group is also acquiring expertise in the examination and typing of glycogen-storage diseases, congenital disorders of metabolism that lead to malfunctioning in the muscles, liver, heart, blood cells and other organs of glycogen storage.

Summary of research

1. Characterization of glycogen in erythrocytes and leucocytes and new methods for its determination.
2. Glycogen-hydrolysing enzymes of skeletal muscle and liver; their purification and characterization, with special reference to the hydrolysis of the branch linkages of glycogen.
3. Enzymic synthesis of the branch linkages of glycogen.
4. Reactivity of glycogen towards enzymes as a function of molecular weight and in particular molecular surface area.
5. Correlation of glycogen-metabolizing enzymes of animals with those of the glycogen-storing plant sweet corn (*Zea mays*).

RESEARCH GROUP IN ENZYMOLOGY

Department of Chemical Pathology, St. Mary's Hospital Medical School,
London W.2
(Ambassador 1280)

Honorary Director
Professor A. Neuberger, C.B.E., F.R.S.

Staff

P. W. Inward, Ph.D.

G. H. Tait, Ph.D.

Visiting and attached workers

A. Gorchein, M.B., M.R.C.P. (*MRC Junior Research Fellow*)

Mrs. A. Mazanowska, Ph.D. (*Institute of Nuclear Research, Polish Academy of Sciences*)

The Group is continuing its work on the formation of porphyrins and bacteriochlorophyll and related enzymic problems. The Group is also examining the composition and formation of chromatophores in photosynthetic micro-organisms.

Summary of research

1. The formation of zinc protoporphyrin and haem catalysed by enzymes in chromatophores and guinea pig liver mitochondria; purification of lipids and their role in the reactions.
2. Amounts and distribution of phospholipids and enzymes in subcellular fractions of photosynthetic micro-organisms under different growth conditions: an attempt to elucidate the mode of formation of chromatophores.

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RESEARCH GROUP IN HAEMOLYTIC ANAEMIA

Department of Haematology, University College Hospital Medical School, Gower Street, London W.C.1

(Euston 5861)

Honorary Director
Professor T. A. J. Prankerd M.D., F.R.C.P.

Staff

A. J. Bowdler, M.D., M.R.C.P.
B. D. Gomperts, B.Sc. (*honorary*)
E. R. Huens, M.C.Path., Ph.D., M.D. (*honorary*)

Visiting worker
Mrs. E. Tibbling, M.D. (*University of Gothenburg*)

The aims of the group are to study the causation of haemolytic anaemias at the biochemical, cellular and clinical levels.

Summary of research

1. Haemoglobin synthesis in normal and thalassaemic red cell precursors.
2. Determination of the molecular abnormality in various abnormal (unstable) haemoglobins causing haemolytic anaemia.
3. Dissociation of haemoglobin.
4. Investigation of methods of detecting organ pooling of red cells in man and the relevance of pooling to red cell survival and dilution anaemia.
5. Metabolic changes in human red cells during *in vitro* incubation.
6. Investigation of enzyme defects in haemolytic anaemias.

RESEARCH GROUP ON THE IMMUNOLOGICAL ASPECTS OF DERMATOLOGY

Institute of Dermatology, St. John's Hospital for Diseases of the Skin, Homerton Grove, London E.9

(Amherst 7061)

Director
J. L. Turk, M.D.

Staff
Miss A. B. Wilson, Ph.D.

Visiting workers

A. A. Blazkovec, Ph.D. (*Schweizerisches Forschungsinstitut für Hochgebirgsklima und Medizin, Davos*)
J. V. Diengdoh, M.B. (*Royal College of Surgeons*)
H. Seabra Santos, M.D. (*Hospital Rovisco Pais, Tocha, Portugal*)
A. Varelzidis, Dip.Med. (*Evangelismos Hospital, Athens*)

The Group is investigating the mechanism of contact sensitivity and delayed hypersensitivity in the guinea pig. The work is particularly concerned with certain large pyroninophilic cells present in greatest concentration four days after primary contact with a sensitizing agent, one day before the animal begins to manifest sensitivity. The group is also instituting research on the development and application of immunological methods and techniques for the investigation of skin diseases.

Summary of research

1. Chemical characterization of proteins and peptides produced by large pyroninophilic cells, using the techniques of immunofluorescence, incorporation of ^{14}C-labelled amino acids, autoradio-immunoelectrophoresis and ion exchange chromatography.
2. Histological demonstration of the specificity of the large pyroninophilic cell during the development of contact sensitivity.

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3. Demonstration of cell types developed from large pyroninophilic cells during the development of contact sensitivity using histology and autoradiography.
4. Local passive transfer of tuberculin sensitivity in inbred histocompatible guinea pigs by means of subcellular particles.
5. Electron microscopy of local lymph nodes during the development of contact sensitivity (in collaboration with Professor B. Pernis of the University of Milan).
6. Investigation of the possible immunological basis of certain skin diseases (in collaboration with the clinical staff of St. John's Hospital).

CLINICAL IMMUNOLOGY RESEARCH GROUP

Institute of Diseases of the Chest, Brompton Hospital,
London S.W.3
(Flaxman 3707)

Director
J. Pepys, M.B., M.R.C.P.

Staff

Miss J. Faux, B.Sc.
Miss V. Holford-Strevens, B.Sc.
P. A. Jenkins, Ph.D.
Miss J. L. Longbottom, Ph.D.

The Group is investigating the immunological responses in man to the common pathogenic and non-pathogenic fungi, to organic vegetable dusts and to mycobacteria, and the relationship of the immunological findings to clinical manifestations in pulmonary disorders. Controlled studies in the management of allergic disorders are being conducted.

Summary of research

1. (*a*) Separation and identification of antigens and allergens from *Aspergillus fumigatus* and their investigation in patients suffering from broncho-pulmonary aspergillosis.
   (*b*) Incidence of *A. fumigatus* infection in patients with open-healed cavities in treated pulmonary tuberculosis (with the British Tuberculosis Association).
2. (*a*) Nature and development in mouldy hay of antigens responsible for farmer's lung, and their testing in affected subjects; antigenic composition of mouldy hays produced under laboratory conditions (with Dr. P. H. Gregory, Rothamsted Experimental Station).
   (*b*) Epidemiological and immunological aspects of farmer's lung.
   (*c*) Epidemiological and immunological aspects of fog fever in cattle (with the Veterinary Clinical Observation Unit).
   (*d*) Antigenicity of mesophilic and thermophilic actinomycetes in man and animals.
3. (*a*) Nature and development in different vegetable and other organic dusts of antigens relevant to immunological responses in exposed subjects: correlation of results with clinical findings.
   (*b*) Antigenic relationships between vegetable dusts and other mycological flora.
4. Immunological responses in man to the antigens of *Myco. tuberculosis* and the 'atypical' mycobacteria.
5. Controlled studies of the role of allergy to house dust in asthma and the effects of specific hyposensitization (with the British Tuberculosis Association).

RESEARCH GROUP ON THROMBOSIS

Department of Pharmacology, Royal College of Surgeons of England,
Lincoln's Inn Fields, London W.C.2
(Holborn 3474)

Honorary Director
Professor G. V. R. Born, M.B., D.Phil.

Staff
D. C. B. Mills, M.A.

Visiting and attached workers

R. Haslam, M.A., D.Phil. (*Imperial Chemical Industries Ltd.*)
R. Philp, D.V.M., Ph.D. (*University of Western Ontario*)
Mrs. H. M. Payling Wright, Ph.D., L.M.S.S.A. (*MRC external scientific staff*)

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The Group is concerned with research into chemical substances which promote or prevent the adhesion and aggregation of platelets in the blood and which affect the formation of thrombi.

Summary of research

1. Investigation into the mechanisms which cause blood platelets to adhere to vascular endothelium and to each other to form aggregates *in vivo* and *in vitro*.
2. Experimental production of thrombosis in animals and its inhibition by chemical substances.
3. Influence of chemical substances on thrombogenesis in man.
4. Biochemical mechanism controlling the concentrations of circulating platelets in animals and in man.

RESEARCH GROUP IN APPLIED NEUROBIOLOGY

Institute of Neurology, Queen Square, London W.C.1
(Terminus 3611)

Director
J. B. Cavanagh, M.B., M.R.C.P.

Staff

Miss M. E. Dennison, B.A.
H. Hillman, M.B., Ph.D.
D. N. Landon, M.B.
D. Matheson, B.Sc.
R. S. Mellick, M.B., M.R.C.P.

Visiting and attached workers

G. Benassi, M.D. (*Istituto di Patologia Generale, Ferrara*)
Jean M. Jacobs, B.Sc. (*Polio Research Fund*)

The aims of this Group are to study the relationships of the supporting and neuroglial cells in the peripheral and central nervous system to neurones.

Summary of research

1. Physiological properties of isolated neurones.
2. Fine structure of Ranvier's node.
3. Fine structure of the muscle spindle.
4. Protein synthesis in Schwann cells.
5. Permeability of the vascular bed of peripheral nerve in experimental states.
6. Remyelination process in Schwann cells after selective demyelination by diphtheria toxin.
7. The metabolic lesion in organophosphorus neurotoxicity.

OCULOGENITAL VIRUS RESEARCH GROUP

Virus Research Laboratory, Department of Clinical Ophthalmology,
Institute of Ophthalmology, Judd Street, London W.C.1
(Euston 9621)

Honorary Director
Professor Barrie R. Jones, B.Sc., M.B., F.R.C.S.

Staff

E. M. C. Dunlop, M.D., M.R.C.P. (*part-time*)
J. A. Garland, B.Sc.
I. A. Harper, M.B., M.C.Path.

The Group is interested in certain aspects of the biology of TRIC agent, a member of the psittacosis–lymphogranuloma–trachoma (PLT) group of agents, and in disease caused by this agent. It is particularly concerned with TRIC agent infection of the eye in adults and the newborn, and with associated disease of the genital tract. Abnormal conditions of the genital tract and rectum related to infection with this agent are being studied, with particular reference to the problem of non-specific urethritis. Clinical, virological, immunological and epidemiological methods are employed in this work.

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Summary of research

1. Clinical, cytological and virological studies of:
   (*a*) the eye and genital tract in cases of trachoma and inclusion conjunctivitis syndromes, in both adults and the newborn;
   (*b*) the urethra in cases of non-specific urethritis;
   (*c*) the genital tracts of the sexual contacts of patients with trachoma, inclusion conjunctivitis or non-specific urethritis.
2. Comparison of established cytological methods, fluorescent antibody methods and virus isolation methods in the diagnosis of TRIC agent infections.
3. Identification of strains or sub-types of TRIC agent, by means of fluorescent antibody and other immunological methods.
4. Fluorescent and electron microscope studies of certain strains, which appear to possess unusual biological features of morphology and growth pattern.
5. Examination of the roles of hypersensitivity and toxicity in the pathogenesis of trachoma, using as biological models the eyes of experimental animals of different species.
6. Determination of the range of animal hosts and of the pathogenicity of the agent and clarification of the relationship between it and other members of the PLT group.
7. Epidemiology of TRIC agent infections, with special interest in their sexual transmission in the United Kingdom.

RESEARCH GROUP FOR THE STUDY OF MEGALOBLASTIC ANAEMIAS

Postgraduate Medical School of London,
Ducane Road, London W.12
(Shepherds Bush 2030)

Honorary Director
D. L. Mollin, M.B., B.Sc., M.C.Path.

Staff
Miss B. B. Anderson, Ph.D.
Miss E. B. Harriss, Ph.D. (*until July 1964*)
A. V. Hoffbrand, M.A., M.R.C.P., D.C.P.

Visiting and attached workers
Miss J. Cowan, B.Sc. (*World Health Organization*)
J. D. Hines, M.D. (*National Institutes of Health Fellow*)
S. Kremenchuzky, M.D. (*Consejo Nacional de Investigaciones Cientificas y Tecnicas Argentina Fellow*)
Miss B. H. MacGibbon, B.M. (*National Institutes of Health*)
Mrs. M. Potter, B.Sc. (*National Institutes of Health*)
J. Reed, M.D. (*National Science Foundation Fellow*)
Miss A. Unwin, B.Sc. (*Wellcome Trust*)

The Group is concerned with the study of the pathogenesis of megaloblastic anaemia and with the metabolism of vitamin B_{12}, folic acid and pyridoxine. It acts as the reference centre for studies on vitamin B_{12} and folic acid for the WHO Research Project on Nutritional Anaemias and is responsible for the co-ordination of the Wellcome Research Study on Tropical Nutritional Anaemia. The Group also carries out B_{12}, folic acid and iron assays for the MRC Laboratories in the Gambia.

Summary of research

1. Determination of the severity and cause of the widespread folate deficiency revealed by new methods of studying folic acid metabolism.
2. Interrelationship of the function of vitamin B_{12} and folic acid.
3. Definition and classification of the group of conditions referred to as the sideroblastic anaemias.
4. Experimental production of sideroblastic anaemia in animals.
5. Development of biochemical and microbiological methods for investigating pyridoxine metabolism in man.

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CARDIOVASCULAR RESEARCH GROUP

Postgraduate Medical School of London,
Ducane Road, London W.12
(Shepherds Bush 2030)

Director

J. P. Shillingford, M.D., F.R.C.P. (*part-time*)

Staff

D. H. Bergel, M.B., Ph.D.
I. Gabe, M.D., M.R.C.P.
D. Reid, Ph.D.

Visiting and attached workers

O. W. Boicourt, M.D. (*National Institutes of Health Fellow*)
R. Chiesa, M.D. (*British Council Fellow*)
S. J. Fillmore, M.D. (*National Institutes of Health Fellow*)
G. Makin, F.R.C.S. (*Postgraduate Medical School of London; Surgical Research Fellow*)
R. Malmcrona, med. lic. (*Swedish Medical Research Council*)
C. J. Mills, B.Sc. (*Royal Society Paul Instrument Fund Research Fellow*)
A. Mourdjinis, M.D. (*University of Athens Fellow*)
R. E. Nagle, M.B., M.R.C.P. (*Postgraduate Medical School of London*)
B. L. Pentecost, M.B., M.R.C.P. (*Postgraduate Medical School of London*)
D. Pomerantz, M.D. (*Canadian Heart Foundation Research Fellow*)
J. A. Reid, M.D. (*National Institutes of Health Fellow*)
M. Thomas, M.B., M.R.C.P. (*MRC Junior Research Fellow*)

The Group is concerned with the study of the circulation in health and disease, with special emphasis on coronary heart disease. The research programme includes the development of new methods designed to improve the early diagnosis of heart disease and the investigation of both coronary and hypertensive heart disease. These investigations are augmented by basic laboratory studies, including research into the biophysics of circulation.

Summary of research

1. Studies in association with the intensive care unit for coronary thrombosis.
2. Direct measurement of blood flow in man and its application to the study of resistance to blood flow in the pulmonary artery and aorta in health and disease.
3. Study of the circulation by indicator substances including radioisotopes:
   (*a*) Measurement of cardiac output and coronary artery flow.
   (*b*) Measurement of local venous flow and its application to the study of renal and arterial disease.

CLINICAL RESPIRATORY PHYSIOLOGY RESEARCH GROUP

Department of Medicine, Postgraduate Medical School of London,
Ducane Road, London W.12
(Shepherds Bush 2030)

Director

J. B. West, M.D., Ph.D.

Staff

J. E. Maloney, M.Sc.
M. C. F. Pain, M.B., M.R.A.C.P.

Visiting and attached workers

C. T. Dollery, M.B., M.R.C.P. (*Postgraduate Medical School of London*)
H. Simon, M.D. (*University of Munich*)
P. Zardini, M.D. (*University of Turin*)

This Group is studying the distribution of blood flow and ventilation in the lung and the factors determining pulmonary vascular resistance. Studies are made of the normal lung and of patients with lung and heart disease.

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Summary of research

2.5

1. Influence of vascular, perivascular and alveolar pressures on the distribution of pulmonary blood flow and ventilation.
2. Effects of changes in the distribution of pulmonary blood flow on pulmonary vascular resistance and gas exchange.
3. Blood flow distribution in the lungs of patients with pulmonary venous hypertension and bronchitis.

RESEARCH GROUP IN MEDICAL DEMOGRAPHY

Department of Medical Statistics and Epidemiology,
London School of Hygiene and Tropical Medicine,
Keppel Street and Gower Street, London W.C.1
(Museum 3041; Langham 7621)

Honorary Director
W. Brass, M.A.

Staff
to be appointed

Medical demography is concerned both with the effects of changes in population size and structure on disease (particularly in terms of vital statistics and morbidity) and with the influence of medical developments on population characteristics. The main sources of material for investigation are population censuses, vital registration and special surveys. The Group has been established to carry out theoretical and applied research on the interrelations of population distribution and disease incidence, the uses of demographic techniques in the study of medical problems and the development of methods for improving the reliability of vital and health statistics and for deriving significant measures from them.

Summary of research

1. Techniques for the projection of time series of fertility and mortality rates as an aid to forecasting.
2. Comparison of mathematical models of the age incidence of mortality with observations and uses of the models for forecasting and for adjusting unreliable data.
3. Birth spacing and infant mortality rates.

University of Newcastle upon Tyne

RESEARCH GROUP ON THE RELATION OF FUNCTIONAL TO ORGANIC PSYCHIATRIC ILLNESS

Department of Psychological Medicine, 11 Framlington Place,
Newcastle upon Tyne 2
(Newcastle 25136)

Honorary Director
Professor M. Roth, M.D., F.R.C.P., D.P.M.

Staff

M. W. Atkinson, M.B., M.R.C.P.E., D.P.M.
G. Blessed, M.B., M.R.C.P.E., D.P.M.
C. Gurney, M.B., D.P.M.
D. W. K. Kay, D.M., D.P.M. (*honorary*)
D. Romney, B.Sc., Dip.Psych., A.B.Ps.S.
B. E. Tomlinson, M.B., M.R.C.P. (*honorary*)

The Group is specially concerned with investigations in the indeterminate territory between functional and organic forms of mental disorder. In particular it is setting out to utilize information about those forms of mental disorder

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which have known cerebral or organic causes in order to shed light on the causation of mental disorders with a similar or identical picture in which aetiological factors are obscure or unknown. In the course of this work clinical, statistical, neuropathological and biochemical techniques are being employed.

Summary of research

1. Assessment of thyroid function and pattern of psychiatric disorder in cases clinically diagnosed as (*a*) thyrotoxicosis, (*b*) possible thyrotoxicosis and (*c*) anxiety neurosis; computer analysis of a large number of items to assess the relative discriminating value of a wide range of physical and psychiatric features.
2. Neuropathology of functional and organic mental disorders in old age.
3. Relationship between clinical and psychometric scores of dementia and quantitative assessment of cerebral degenerative change in old people at necropsy.
4. The contributions of genetic, organic and environmental factors to the aetiology of schizophrenia, studied by:
   (*a*) systematic psychiatric and medical evaluation of a consecutive sample of schizophrenic patients;
   (*b*) psychometric and EEG investigations;
   (*c*) a comprehensive family survey in which genetic and environmental factors, together with current personality features, are assessed in first degree relatives.
5. Computer analysis of psychiatric and social observations in patients suffering from anxiety, phobic and depressive states.
6. Psychiatric disturbance in a consecutive series of patients with cerebral tumour.
7. Biochemical and physiological changes associated with affective disorders.

University of Oxford

RESEARCH GROUP ON ADRENERGIC MECHANISMS

University Laboratory of Physiology, Oxford

(Oxford 57451)

Honorary Director

Professor Sir Lindor Brown, C.B.E., M.B., M.Sc., F.R.C.P., F.R.S.

Staff

A. G. H. Blakeley, B.A.
D. P. Dearnaley, M.A., D.Phil.
C. B. Ferry, B.Sc., B.Pharm. (*until Aug. 1964*)

Attached worker

L. B. Geffen, M.B., B.Ch., M.Sc. (*Nuffield Dominions Demonstrator*)

The Group is studying the factors regulating the release and inactivation of the substance transmitting the effects of adrenergic nerves.

Summary of research

1. Uptake and release of isotopically labelled noradrenaline by the isolated perfused spleen.
2. Factors controlling storage and synthesis of transmitter.

University of Sheffield

RESEARCH GROUP ON BIOCHEMISTRY AND PHYSIOLOGY OF INTRACELLULAR ORGANELLES

University Department of Biochemistry, Sheffield 10

(Sheffield 78555)

Honorary Director

Professor W. Bartley, M.A., Ph.D.

Staff

E. Bailey, B. Sc.
D. W. Gregory, Ph.D.
C. B. Taylor, Ph.D.

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The Group is studying the metabolic implications of the segregation of biochemical reactions within organized subcellular structures.

Summary of research

1. Measurement of turnover rates of mitochondrial constituents, particularly protein fractions and phospholipids.
2. Experiments to elucidate the role of the essential fatty acids (EFA): the effect of EFA deficiency in rats on liver mitochondria and intestinal function, coupled with electron microscope studies of the ultrastructure of deficient tissues.
3. Immunochemical studies on the morphogenesis of yeast mitochondria.
4. Development of a ferritin-labelled antibody technique for specific staining of preparations for electron microscopy.

University College of South Wales and Monmouthshire

RESEARCH GROUP ON THE BIOCHEMISTRY OF CONNECTIVE AND LUNG TISSUES

Department of Biochemistry, University College of South Wales and Monmouthshire, St. Andrew's Place, Cardiff

(Cardiff 24892)

Honorary Director

Professor K. S. Dodgson, Ph.D., D.Sc.

Staff

D. B. Johnson, Ph.D.
A. G. Lloyd, Ph.D. (*honorary*)
N. Tudball, Ph.D. (*honorary*)
F. S. Wusteman, Ph.D.

Attached workers

G. Embery, B.Sc. (*University of Wales Scholar*)
J. H. Thomas, B.Sc. (*MRC Scholar*)

The Group is engaged on fundamental biochemical studies on the connective tissues and, in particular, on the response of lung tissue to the stimulus of mineral particles.

Summary of research

1. Constitution of the aminopolysaccharide-protein complexes of the connective tissues.
2. Metabolic routes involved in the disposal of aminopolysaccharides in mammals.
3. Enzymes as analytical tools in studies on connective tissue constituents.
4. Biochemical changes induced in mammalian lung in response to coal dust.

RESEARCH GROUP ON THE STRUCTURE AND FUNCTIONS OF MICRO-ORGANISMS

Microbiology Department, University College of South Wales and Monmouthshire, Cathays Park, Cardiff

(Cardiff 27483)

Honorary Director

Professor D. E. Hughes, Ph.D.

Staff

T. Coakley, M.Sc.
A. Comer, B.S.A., M.S.A.
J. Wimpenny, B.A., Ph.D.

Attached Workers

Mrs. H. Cole, B.A. (*MRC Scholar*)
J. Cole, B.A. (*MRC Scholar*)
A. Griffiths (*DSIR Scholar*)

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The Group has started to investigate the enzymological constitution of facultative anaerobes, with particular reference to those enzymes located in the cytoplasmic membrane. Work is now to begin on the biological effects of ultrasound.

Summary of research

1. The role of a soluble cytochrome C in the respiration of *Escherichia coli.*
2. Flavoenzymes in facultative aerobes.
3. Effects of ultrasound on (*a*) the metabolism of micro-organisms and (*b*) on the metabolism of inner ear tissues (with Mr. J. A. James, University of Bristol).

University of Strathclyde

BIOMECHANICS RESEARCH GROUP

Bio-engineering Unit, Department of Mechanical Engineering,
University of Strathclyde, Glasgow C.1
(Bell 4400)

Honorary Director
Professor R. M. Kenedi, Ph.D., A.R.C.S.T., A.M.I.Mech.E., A.F.R.Ae.S.

Honorary Clinical Directors
Professor R. Barnes, M.B., B.Sc., F.R.C.S.
T. Gibson, M.B., F.R.C.S.E., F.R.C.S.G.

Staff

T. C. Duggan, B.Sc., A.Inst.P.
J. Hughes, A.R.C.S.T. (*part-time*)
J. MacGregor, Ph.D.
J. P. Paul, B.Sc., A.R.C.S.T., A.M.I.Mech.E. (*part-time*)
E. R. Robertson, B.Sc., A.R.C.S.T., A.M.I.Mech.E. (*part-time; until Oct. 1964*)
D. S. Ross, Ph.D., A.R.C.S.T., A.M.I.Mech.E., A.M.Prod.E., A.M.Inst.R. (*part-time*)
C. Sorbie, M.B., F.R.C.S.E. (*honorary*)
R. Zalter, M.D. (*until Sept. 1964*)

The basic aim of the Group is the investigation of the structural and mechanical properties of human tissues, the engineering principles underlying their function and any practical clinical applications which may arise from these. The Group operates under the general guidance of a medical-engineering steering committee, the engineering investigations being closely correlated with associated clinical studies.

Summary of research

1. Skin tensions:
   (*a*) Determination of the physical and mechanical characteristics of human skin and formulation of a theory to describe in analytical terms its mechanical behaviour.
   (*b*) Determination of the normal and blanching tension patterns in the skin of the human body, with reference to the directions and relative values of maximum and minimum tensions.
   (*c*) Analytical and experimental investigation of the phenomena of skin stretch, its correlation with changes in body dimensions, and its influence on scar formation, stitching tension and root blanching of flaps and relaxation of tension across tightly stitched wounds.
   (*d*) Histological studies of stressed skin (with Dr. J. E. Craik and Dr. I. R. R. McNeil, Victoria Infirmary, Glasgow).

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2. Dynamic forces in joints:
   (*a*) Analytical and experimental investigation of the force actions transmitted by the hip joint of the human body during activity, including evaluation of force actions exerted on the body, determination of the inertia effects of the relevant limbs, identification of the muscle groups significant in action with respect to the force transmitted by the joint-bearing surfaces, and the magnitude and line of action of the joint force itself.
   (*b*) Investigation of the force-deformation characteristics of bone and bone-implant combinations *in vivo* and *in vitro*, directed to evaluation of the mechanical characteristics most significant in the development and design of implants.
3. Characteristics of human cartilage:
   (*a*) Determination of the physical and mechanical characteristics of human cartilage and formulation of a theory to describe in analytical terms its mechanical behaviour.
   (*b*) Determination of the self-locked stress actions in human rib cartilage and its functional role in the movement of the rib cage.
   (*c*) Development of techniques for the transplantation of the articular cartilage of the hip joint.

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Research Work Aided by Grants

The Council have always attached much importance to their scheme of grants. These are awarded, normally for a three-year period, to research workers who are not members of their own staff for particular research projects carried out at universities and other centres. Such grants may be for the personal remuneration of individual workers, for the provision of scientific and technical assistance, or for special research expenses. The cost of grants is mostly met from the Council's grant-in-aid, and special reference is made where this is not the case. Grants are also given in a limited number of cases to universities for the purchase of costly equipment ('Special Departmental Apparatus') which will advance the work of one or more departments. These grants are specifically indicated in the following list, which includes grants awarded up to the end of 1964. Information about the number of grants awarded by the Council and the acceptance rate of applications will be found on p. 15.

Aberdeen

TEACHING HOSPITALS

Dr. W. N. ROLLASON—assistance and expenses: use of nitrous oxide oxygen mixtures for the relief of postoperative pain. (1)

UNIVERSITY

Anatomy Department

Dr. J. MCKENZIE—(1) assistance: effect of antimycin A and other materials on the developing chick embryo; (2) assistance: teratogenic action of insulin in the explanted chick embryo. (2)

Biological Chemistry Department

Dr. D. C. BURKE—(1) expenses: methods for the purification of interferon, and its formation and mode of action in tissue culture cells; (2) assistance and expenses: production of interferon. (3)

Dr. J. W. PORTEOUS—(1) assistance and expenses: biochemical activities of subcellular components of intestinal mucosal cells; (2) expenses: biochemical and electron microscope investigations on intestinal epithelium. (4)

Dr. J. L. SIMKIN—assistance and expenses: role of the microsome material in protein biosynthesis in mammalian cells. (5)

Chemical Pathology Department

Mr. N. G. C. HENDRY—assistance and expenses: relationship of glycosidases to abnormalities of connective tissue. (6)

Child Health Department

Professor R. G. MITCHELL—assistance and expenses: respiratory distress syndrome of newborn infants. (Also at Aberdeen Maternity Hospital.) (7)

Department of Materia Medica and Therapeutics

Dr. J. CROOKS—assistance and expenses: thyroid function and iodine metabolism in normal and abnormal pregnancy. (8)

Dr. J. M. STOWERS—assistance and expenses: metabolic defects in diabetes mellitus with particular reference to fat metabolism. (9)

Mental Health Department

Professor W. M. MILLAR—assistance (from private funds at the Council's disposal) for the departmental research programme. (10)

Midwifery and Gynaecology Department

Professor Sir Dugald BAIRD—(1) assistance and expenses: social aetiology of carcinoma of the cervix uteri; (2) assistance and expenses: assay of oestriol and pregnanediol in urine. (11)

Dr. A. C. TURNBULL—assistance and expenses: uterine activity with special reference to prolonged pregnancy and labour. (12)

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Pathology Department

Professor A. R. CURRIE—expenses: oxygen consumption of tumour cells. (13)

Physiology Department

Dr. C. V. GREENWAY—assistance and expenses: cardiac output, regional blood flow and oxygen uptake in haemorrhagic shock. (14)

Professor J. L. MALCOLM—(1) assistance and expenses: mode of action of substances that alter cerebral electrical activity; (2) expenses: an investigation of the sera of schizophrenic patients. (15)

Psychology Department

Mr. A. E. BURSILL—expenses: methods of measuring 'attention'. (16)

Surgery Department

Mr. C. G. CLARK—assistance and expenses: absorption from intestine following procedures which alter gastric secretion. (17)

Professor G. SMITH—assistance and expenses: hyperbaric oxygenation in barbiturate coma, coronary artery occlusion and left ventricular failure, and in tissue culture. (18)

Aberystwyth

UNIVERSITY COLLEGE OF WALES

Botany Department

Dr. A. D. BONEY—expenses: effects of carcinogens and fluorescent substances on growth and viability of marine algae (in association with the Plymouth Laboratory of the Marine Biological Association of the United Kingdom). (19)

Alverstoke

ROYAL NAVAL MEDICAL SCHOOL

Professor W. L. M. PERRY—assistance and expenses: the causation and treatment of motion sickness. (20)

Ascot

IMPERIAL COLLEGE FIELD STATION

Zoology and Applied Entomology Department

Dr. Elizabeth U. CANNING—assistance and expenses: mode of sexual differentiation in *Coccidia*. (21)

Ashford, Kent

WYE COLLEGE

Division of Zoology, Biological Sciences Department

Mr. C. A. FINN—expenses: artificial decidual cell reaction in the uterus of the mouse. (22)

Aylesbury

ST. JOHN'S HOSPITAL

Dr. J. L. CRAMMER and Dr. D. C. WATT—assistance and expenses: relation of the metabolism of imipramine to clinical response. (23)

STOKE MANDEVILLE HOSPITAL

National Spinal Injuries Centre

Dr. L. GUTTMANN—expenses: effects of disease and injury to the spinal cord. (24)

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Babraham

AGRICULTURAL RESEARCH COUNCIL INSTITUTE OF ANIMAL PHYSIOLOGY

Dr. K. KRNJEVIC—assistance and expenses: neuronal inhibition and distribution of choline acetylase in the cerebral cortex. (25)

Dr. R. A. MILLAR—expenses: (i) acid-base changes and baroreceptor and sympathetic activity during general anaesthesia; (ii) respiratory and metabolic changes during prolonged neurosurgical operations. (Also at Addenbrooke's Hospital, Cambridge.) (26)

Bangor

UNIVERSITY COLLEGE OF NORTH WALES

Psychology Department

Mr. P. HARZEM—expenses: (i) response-induced conflict; (ii) conflict as a determinant of deviation from stable behaviour. (27)

Barton-on-Humber

PUBLIC HEALTH DEPARTMENT

Dr. J. S. ROBERTSON—personal and expenses: toxoplasmosis as a cause of stillbirth, infant deaths and morbidity in children. (28)

Bath

ROYAL NATIONAL HOSPITAL

Dr. G. D. KERSLEY and Dr. J. A. COSH—expenses: neuropathy and myopathy in the connective tissue diseases. (29)

Beckenham

BETHLEM ROYAL HOSPITAL

Dr. E. H. HARE—expenses: epidemiological study of mental health in two areas of Croydon. (30)

Dr. W. LINFORD REES—assistance and expenses: psychological relationships in depressive illness. (31)

Belfast

ROYAL VICTORIA HOSPITAL

Departments of Metabolism and Neurology

Dr. L. J. HURWITZ and Dr. D. A. D. MONTGOMERY—assistance and expenses: electromyographic study of certain neuromuscular complications of diabetes. (32)

THE QUEEN'S UNIVERSITY

Botany Department

Dr. D. PARK and Dr. P. M. ROBINSON—assistance and expenses: effects of ageing on fungal cultures. (33)

Department of Medicine

Professor G. M. BULL—assistance and expenses: regulation of the volume of water in the body. (34)

Dr. Mary G. MCGEOWN—assistance and expenses: assay of parathyroid hormone in the human subject. (35)

Microbiology Department

Professor G. W. A. DICK—expenses (from special funds for the purchase of costly apparatus): viral morphology. (36)

Psychology Department

Dr. R. G. A. STRETCH—assistance and expenses: effects of stress in pregnant rats on the behaviour of the offspring. (37)

Therapeutics and Pharmacology Department

Professor O. L. WADE—(1) expenses: experimental bronchitis and emphysema; (2) expenses: survey of pulmonary function in asbestos workers. (38)

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BIRMINGHAM GENERAL HOSPITAL

Dr. W. T. COOKE—(1) expenses: jejunal biopsies; (2) assistance: investigation of the pH changes in the duodenum and jejunum of man in normal and pathological states. (39)

BIRMINGHAM AND MIDLAND HOSPITAL FOR WOMEN

Clinical Endocrinology Department

Dr. A. C. CROOKE—assistance and expenses: action of certain oral contraceptives. (40)

QUEEN ELIZABETH HOSPITAL

Clinical Biochemistry

Professor J. R. SQUIRE—assistance: evaluation of the potential use of data processing systems at the Council's projected Clinical Research Centre. (41)

Department of Medicine

Dr. C. W. CRANE—expenses: small bowel uptake of wheat gluten. (42)

Department of Neurosurgery

Professor E. B. C. HUGHES—assistance and expenses: production of focal lesions in the central nervous system. (43)

Physics Department

Mr. R. F. FARR—assistance: interfacial surface tensions of fine droplets. (44)

Department of Surgery

Mr. B. GOODHEAD and Dr. J. S. MATHER—expenses: effects of intravascular thiopentone and methohexitone. (45)

Mr. E. A. TURNER—assistance: arrest of cerebral circulation during brain surgery. (46)

UNIVERSITY

Anatomy Department

Professor Sir Solly ZUCKERMAN—(1) assistance and expenses: response of foetal tissues to X-irradiation; (2) expenses: gametogenesis; (3) expenses: (i) anatomical variations associated with differences in posture and locomotion; (ii) dimensions and growth of the craniomandibular apparatus; (4) assistance and expenses: the structure and function of the hypothalamo–hypophysial tract in the ferret; (5) expenses (from special funds for the purchase of costly apparatus): ultrastructural studies of comparative neurosecretion, the pituitary in mammals and gametogenesis; (6) assistance and expenses: role of the motoneurone in the determination of functional properties of skeletal muscle. (47)

Bacteriology Department

Dr. K. A. BISSET—assistance and expenses: bacteriology of dental caries. (48)

Biochemistry Department

Dr. H. G. KLEMPERER—expenses: enzymes concerned in RNA synthesis and their relationship to protein synthesis. (49)

Professor S. V. PERRY—assistance and expenses: biological activity and subunit structure of myosin. (50)

Dr. D. G. WALKER—assistance and expenses: development and control of enzyme systems within the developing mammalian foetus and newborn animal. (51)

Chemistry Department

Dr. S. A. BARKER—(1) assistance and expenses: structure and function of mucoproteins in chronic bronchitis; (2) assistance and expenses: carbohydrate moieties of γ-globulins. (52)

Professor R. BELCHER—expenses: submicromethods for the analysis of organic compounds. (53)

Professor M. STACEY—assistance and expenses: preparation of a range of fluorocarbon compounds for test as anaesthetic agents. (54)

Dental Pathology Department

Professor E. A. MARSLAND—assistance and expenses: chemical and histological investigation of enamel formation with particular reference to maturation. (55)

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Experimental Neuropharmacology Department

Dr. G. B. ANSELL—assistance and expenses: relative importance of different pathways of phospholipid synthesis in the various anatomical areas of the brain. (56)

Experimental Pathology Department

Dr. J. D. BLAINEY—assistance and expenses: biochemical studies on cases of mental handicap of unknown aetiology. (57)

Mr. S. J. CREWS—personal: the vitreous body of the eye. (58)

Dr. P. W. DYKES—assistance and expenses: (i) irradiation of the reticulo-endothelial system; (ii) effects of radiation on regional blood flow. (59)

Professor P. G. H. GELL—(1) assistance and expenses: immunological and genetic investigation of human and animal globulins; (2) expenses: genetically labelled serum proteins (allotypes). (60)

Dr. J. HARDWICKE—assistance and expenses: physical and biological properties of antigen-antibody complexes. (61)

Professor D. V. HUBBLE—expenses (from special funds for the purchase of costly apparatus): liquid scintillation counter for β-emitting isotopes. (62)

Professor J. R. SQUIRE—expenses: hypogammaglobulinaemia. (63)

Dr. K. W. WALTON—assistance: reaction of rheumatoid factor with isolated polypeptide chains of γG-globulin. (64)

Medical Biochemistry and Pharmacology Department

Dr. R. R. A. DILS—assistance: development of gas-liquid radiochromatography for lipid analysis. (65)

Professor A. C. FRAZER—(1) expenses: problems of fat absorption and other metabolic studies; (2) assistance and expenses: folic acid metabolism; (3) expenses: intracellular phase of fat absorption; (4) expenses (from special funds for the purchase of costly apparatus): measurement of intestinal radiation. (66)

Dr. J. N. HAWTHORNE—assistance and expenses: inositol phospholipids and cation transport in nervous tissue. (67)

Department of Medicine

Professor W. M. ARNOTT—assistance and expenses: (i) metabolic effects of exercise; (ii) human plasma lipids. (68)

Dr. J. M. BISHOP—assistance and expenses: chronic bronchitis and emphysema. (69)

Neurocommunications Research Unit

Dr. I. C. WHITFIELD—(1) assistance and expenses: neural mechanisms of hearing; (2) expenses (from special funds for the purchase of costly apparatus): study of cochlear potentials. (70)

Paediatrics and Child Health Department

Dr. O. H. WOLFF—assistance: disturbances of lipid metabolism in childhood. (71)

Pathology Department

Dr. D. B. BREWER and Dr. D. A. HEATH—assistance and expenses: pathology of emphysema and its relation to disturbances of respiratory function and pulmonary haemodynamics. (72)

Dr. D. L. WOODHOUSE—expenses: biological testing of mineral oil fractions (on behalf of the Committee on the Carcinogenic Action of Mineral Oils). (73)

Physics Department

Dr. J. H. FREMLIN—assistance and expenses: (i) structure of mature enamel; (ii) fluoride content of the dental plaque. (74)

Physiological Chemistry Department

Dr. Sybil P. JAMES—assistance: formation of mercapturic acids. (75)

Dr. C. E. ROWE—assistance and expenses: lipid metabolism in brain tissue. (76)

Physiology Department

Dr. J. D. CUMMING—expenses: capillary circulation in human bone marrow. (Also in Medical Department.) (77)

Dr. E. H. L. HARRIES—expenses: relationship between gastric blood flow and secretion. (78)

Professor S. M. HILTON—expenses: investigation of the nervous pathways controlling the defence reaction. (79)

Dr. F. A. JENNER—assistance and expenses: diuresis and antidiuresis in periodic psychotics. (80)

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Dr. Bertha SINGER—assistance and expenses: regulation of aldosterone secretion in normal and pathological conditions. (81)

Schoo of Dental Surgery

The late Professor A. B. MACGREGOR—expenses: bacteriology of the dental plaque studied by means of the ' artificial mouth ' technique. (82)

Social Medicine Department

Professor T. MCKEOWN—assistance: effect of prenatal factors on postnatal development. (83)

Social Study Department

Professor F. LAFITTE—assistance and expenses: investigation of domestic accidents to elderly persons. (84)

Department of Surgery

Mr. J. G. GRAY—expenses: tissue typing. (85)

Bracknell

HEATING AND VENTILATING RESEARCH ASSOCIATION LABORATORIES

Mr. N. S. BILLINGTON—assistance and expenses: ventilation and air-conditioning of hospital operating theatres. (86)

Bradford

INSTITUTE OF TECHNOLOGY

Biological Sciences Department

Mr. T. CROSS—assistance and expenses: taxonomy of Actinomycetes. (87)

Dr. G. SHAW—assistance and expenses: nucleic acid synthesis. (88)

Pharmacy Department

Dr. J. M. FOY—expenses: factors affecting water transport in the gastro-intestinal tract. (89)

ROYAL INFIRMARY

Dr. Margaret A. HAIGH—personal and expenses: aetiology of infantile hypertrophic pyloric stenosis. (Also at other hospitals in Yorkshire.) (90)

Braintree

Black Notley Hospital

Mr. M. C. WILKINSON—expenses: skeletal tuberculosis and rheumatoid arthritis. (91)

Brighton

ROYAL SUSSEX COUNTY HOSPITAL

Biochemistry Department

Dr. C. RILEY—expenses: sterol ester metabolism in relation to the adrenal gland. (92)

Bristol

BURDEN NEUROLOGICAL INSTITUTE.

Physiological Department

Dr. W. GREY WALTER—expenses: analysis of human brain responses evoked by associated physiological and social stimuli. (93)

COLLEGE OF SCIENCE AND TECHNOLOGY

Dr. N. F. TAYLOR—expenses: synthesis of potential inhibitors of carbohydrate and nucleic acid metabolism. (94)

GENERAL HOSPITAL

Pathology Laboratory

Miss M. P. ENGLISH—assistance: laboratory study of otomycosis and its causal fungi. (95)

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ROYAL HOSPITAL

Medical Physics and Radiodiagnosis Department

Mr. H. F. FREUNDLICH and Mr. M. A. BULLEN—assistance and expenses: use of ultrasonics in medical diagnosis. (Also at Department of Medicine, Bristol Royal Infirmary.) (96)

Radiotherapy Department

Dr. R. C. TUDWAY—expenses: malignant tumour activity assessed by radiophosphorus uptake. (97)

ROYAL INFIRMARY

Mr. W. M. CAPPER and Mr. T. J. BUTLER—assistance and expenses: pH of the mucosa of the stomach. (Also at Frenchay and Southmeads Hospitals.) (98)

Pathology Department

Dr. W. A. GILLESPIE—assistance: hospital cross-infection. (99)

SOUTHMEAD HOSPITAL

Pathology Department

Dr. J. B. HOLTON—expenses: dietary treatment, inheritance and pathogenesis of histidinaemia. (100)

Professorial Department of Obstetrics and Gynaecology

Dr. P. M. DUNN—expenses: foetal adaptation at birth. (101)

UNIVERSITY

Bacteriology Department

Professor K. E. COOPER—(1) assistance: electrophoresis of colicines; (2) assistance: antibiotic action in relation to age of cells. (102)

Dr. Anna J. MAYR-HARTING—assistance: colicine receptors of the bacterial cell. (103)

Biochemistry Department

Professor P. J. RANDLE—(1) assistance: control and interaction of glucose and glyceride metabolism in mammalian tissues; (2) assistance: studies on chondromucoprotein complex; (3) expenses (from special funds for the purchase of costly apparatus): metabolism control in mammalian cells. (104)

Department of Medicine

Dr. J. R. CLAMP—assistance and expenses: isolation and investigation of amyloid. (105)

Professor C. Bruce PERRY—expenses: effect of hypophysectomy on diabetic retinopathy. (Also at Bristol Royal Infirmary.) (106)

Department of Obstetrics and Gynaecology

Professor G. G. LENNON—expenses: vaginal cytology and cytochemistry, assays of urinary oestriol and placental histology in pregnancy. (107)

Organic Chemistry Department

Dr. L. HOUGH—(1) assistance and expenses: biosynthesis of antibiotic amino sugars; (2) assistance and expenses: carbohydrate prosthetic group of immunoglobulins. (108)

Pharmacology Department

Dr. M. GINSBURG—assistance: protein and peptide metabolism in the hypothalamo-neurohypophysial system. (109)

Professor H. HELLER—(1) assistance: renal excretion of histamine; (2) assistance: identification of neurohypophysial hormones of lower vertebrates with special reference to elasmobranch fish. (110)

Dr. K. LEDERIS—assistance: mechanisms of release of neurohypophysial hormones. (111)

Physiology Department

Dr. J. M. N. BOSS—expenses: maturation of the nephron in mammals during the sucking period. (112)

Dr. C. P. HALLETT—expenses: extraction and animal assay of gastrin. (113)

Dr. T. D. WILLIAMS—(1) expenses: the nerve inputs to the globus pallidus and neighbouring structures of the basal ganglia; (2) assistance and expenses: the role of the sensory nervous system in the physiology of the caudate nucleus. (114)

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Psychology Department

The late Professor K. R. L. HALL—assistance and expenses: factors affecting avoidance behaviour and fear responses in monkeys. (115)

Department of Surgery

Mr. J. H. PEACOCK—assistance and expenses: the role of the catecholamines in the maintenance and production of portal hypertension. (Also at Bristol Royal Infirmary.) (116)

Professor R. Milnes WALKER—assistance and expenses: treatment of malignant neoplasms with immunologically competent cells and cytotoxic drugs. (117)

Zoology Department

Dr. H. E. HINTON—expenses: biology and physiology of the Simuliidae. (118)

Dr. A. F. W. HUGHES—(1) assistance and expenses: neuroembryological studies on *Xenopus laevis*; (2) expenses: neuroembryological studies on *Eleutherodactylus*. (119)

Bromley

BROMLEY HOSPITAL

Dr. Elizabeth TYLDEN—personal and expenses: significance of mental illness in pregnancy and the puerperium. (120)

Cambridge

ADDENBROOKE'S HOSPITAL

Department of Medicine

Mr. J. F. R. WITHYCOMBE—assistance and expenses: vesico-ureteric reflux investigated by cystometry and cineradiology. (121)

Investigative Medicine Department

Professor I. H. MILLS—assistance: effect of human pituitary fractions on adrenal steroid synthesis. (122)

John Bonnet Laboratories

Dr. H. LEHMANN—assistance and expenses: biochemistry of skin disease. (123)

Pathology and Radiology Department

Dr. F. R. BERRIDGE—assistance: anatomy of the gastro-oesophageal junction. (124)

Radiotherapeutics Department

Professor J. S. MITCHELL—assistance and expenses: physicochemical studies, including the effects of ionizing radiation on deoxyribonucleoprotein. (125)

DUNN NUTRITIONAL LABORATORY

Dr. Ethel M. CRUICKSHANK—personal: metabolism of ^{14}C-labelled vitamin D_2. (126)

STRANGEWAYS RESEARCH LABORATORY

Dr. E. M. BRIEGER—personal: host-parasite relationship in leprosy. (Also at the National Institute for Medical Research.) (127)

UNIVERSITY

Anatomy School

Dr. G. HORN—assistance and expenses: experimental neurological studies of attention. (128)

Dr. C. C. D. SHUTE and Dr. P. R. LEWIS—expenses: histochemical investigation of the central nervous system following lesions involving fibre tracts in the rat. (129)

Sir William Dunn School of Biochemistry

Dr. E. J. BUTLER—expenses: biochemistry of manganese. (130)

Dr. T. M. CHALMERS—assistance and expenses: characterization of urinary fat-metabolism substance. (131)

Dr. J. B. CHAPPELL—assistance and expenses: relationship between the spatial localization of enzymes in isolated mitochondria and their function. (132)

Dr. H. B. F. DIXON—expenses: chemistry of corticotrophin and the melanophore-stimulating hormone. (133)

Dr. A. KORNER—expenses: hormone control of protein biosynthesis. (134)

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Mrs. A. A. NEWTON—expenses: biochemistry of animal viruses. (135)

Dr. P. K. TUBBS—expenses: study at the enzyme level of the inhibition of fatty acid biosynthesis by fatty acids. (136)

Professor F. G. YOUNG—(1) assistance and expenses: metabolism of orally administered sugars; (2) assistance and expenses: purification of hormones from human pituitary glands. (137)

Colloid Science Department

Dr. D. A. HAYDON—assistance: cell membrane structure and behaviour. (138)

Dr. Paley JOHNSON—assistance: substructure of the larger protein molecules. (139)

Education Department

Professor O. L. ZANGWILL—assistance and expenses: laterality in relation to backwardness in reading. (140)

Department of Experimental Medicine

Miss H. M. BRUCE—personal: reproductive physiology and behaviour. (141)

Genetics Department

Professor J. M. THODAY—expenses (partly from special funds for the purchase of costly apparatus): genetic variation and endocrine function. (142)

Department of Medicine

Dr. D. M. T. GAIRDNER—assistance and expenses: respiratory failure in the newborn. (Also at Cambridge Maternity Hospital.) (143)

Professor I. H. MILLS—assistance: mechanism controlling the excretion of sodium by the kidney. (Also at Addenbrooke's Hospital.) (144)

Metallurgy Department

Dr. T. P. HOAR—assistance and expenses: corrosion, passivity and protection of implant alloys. (145)

Molteno Institute

Dr. Ann BISHOP—personal and expenses: biology of protozoa, with special reference to drug resistance. (146)

Dr. H. W. LASER—personal, assistance and expenses: (i) immediate biochemical changes occurring during application of ionizing irradiation; (ii) resistance to radiation. (147)

Pathology Department

Dr. D. FRANKS—personal and expenses: serological tests for species of origin and antigenic structure of cell strains in culture (in association with the Strangeways Research Laboratory). (148)

Dr. R. M. FRY—personal: preservation of living cells by freezing and drying and the effect of intracellular and extracellular additives on survival. (149)

Pharmacology Department

Professor A. S. V. BURGEN—(1) expenses: microelectrode study of chromaffin cells; (2) expenses: (i) sympathetic nerve terminals; (ii) uptake and release of catecholamines. (150)

Physiology Laboratory

Dr. H. B. BARLOW—expenses: stabilized retinal images. (151)

Dr. G. S. BRINDLEY—expenses: the functions of the cerebellum. (152)

Professor A. L. HODGKIN—assistance and expenses: electrical and mechanical fatigue in single muscle fibres. (153)

Dr. E. N. WILLMER—expenses: ionic movements in the amoeba *Naegleria gruberi* in relation to cell form and differentiation. (154)

Psychological Laboratory

Mr. R. L. GREGORY—assistance and expenses: distance perception and its limitation by 'neural noise'. (155)

Mr. G. C. GRINDLEY—assistance and expenses: role of attention in visual perception. (156)

Mr. A. J. WATSON—assistance and expenses: studies in exploratory behaviour in animals. (157)

Dr. L. WEISKRANTZ—(1) assistance and expenses: memory and temporal lobe function; (2) assistance: cerebral mechanisms of memory in the monkey. (158)

Professor O. L. ZANGWILL—assistance: experimental studies of tactual perception. (159)

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Radiotherapeutics Department

Professor J. S. MITCHELL—(1) expenses: clinical and laboratory studies, using the linear accelerator, on the therapeutic applications of 15-MeV X-rays (from special funds at the Council's disposal); (2) assistance: distribution and possible localization in tumour tissue of tritium-labelled drugs with a view to their possible use as a form of treatment for cancer; (3) assistance: measurement of total body radioactivity in health and disease; (4) assistance: biochemical studies of Synkavit and menadione. (160)

Mrs. I. SIMON-REUSS—personal: the effects of ionizing radiations and chemical agents on malignant cells. (161)

Zoology Department

Professor R. A. HINDE—assistance and expenses: mother-infant interaction in rhesus monkeys. (162)

S udent Expeditions (from private funds at the Council's disposal)

Mr. J. R. COVE-SMITH—expenses: Cambridge Indore Expedition. (163)

Mr. R. G. HARVEY—expenses: blood group distribution of the Ainu—Cambridge Expedition to Northern Japan. (164)

Mr. J. C. RICHARDSON—Cambridge Medico-Sociological Expedition to India. (165)

Cardiff

ROYAL INFIRMARY

Medical Unit

Dr. R. HARVARD DAVIS—assistance and expenses: calcium urinary excretion in a general practice population. (Also at Dr. Harvard Davis's surgery and other centres.) (166)

Surgical Unit

Mr. R. SHIELDS—assistance and expenses: bidirectional transport of water, sodium and potassium across the intestinal mucosa. (167)

TUBERCULOSIS REFERENCE LABORATORY

Dr. P. CAVANAGH—expenses: sensitivity testing of tubercle bacillus (from private funds at the Council's disposal). (168)

UNIVERSITY COLLEGE OF SOUTH WALES AND MONMOUTHSHIRE

Anatomy Department

Dr. F. BECK—expenses: biochemical and embryological nature of experimental teratogenesis. (169)

Biochemistry Department

Professor K. S. DODGSON—assistance and expenses: biochemistry of naturally occurring sulphate esters. (170)

Professor K. S. DODGSON and Dr. A. G. LLOYD—assistance and expenses: bacterial degradation of algal heteropolysaccharides and their monomers. (171)

WELSH COLLEGE OF ADVANCED TECHNOLOGY

Chemistry and Biology Department

Dr. R. E. HUGHES—expenses: passage of ascorbic acid across biological membranes. (172)

Welsh School of Pharmacy

Dr. P. J. NICHOLLS—assistance: nature of biologically active material present in cotton dust and its relation to byssinosis. (173)

WELSH NATIONAL SCHOOL OF MEDICINE

Anaesthetics Department

Professor W. W. MUSHIN—assistance and expenses: uptake and distribution of inhaled anaesthetic agents. (Also at the Royal Infirmary, Cardiff.) (174)

Surgery Department

Professor A. P. M. FORREST—assistance and expenses: gastric hypothermia in man and experimental animals. (175)

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Carshalton

MEDICAL RESEARCH COUNCIL VIRUS RESEARCH UNIT

Electron Microscope Laboratory

Mr. W. J. CRUICKSHANK—expenses: electron microscope investigation of CO_2 sensitivity in *Drosophilia melanogaster* ovaries. (176)

Coventry

COVENTRY AND WARWICKSHIRE HOSPITAL LABORATORY

Dr. D. RIVERS—personal and expenses: relation of X-ray category to content and composition of dust in the lungs and to pathology in simple pneumoconiosis of coal workers. (177)

Dartford

BEXLEY HOSPITAL

Dr. D. BANNISTER—personal, assistance and expenses: conceptual relationships in schizophrenic patients. (178)

Dumfries

CRICHTON ROYAL HOSPITAL

Dr. W. MCADAM—assistance: alcoholism in relation to conditioning and conditioned aversion therapy. (179)

Dundee

MARYFIELD HOSPITAL

Biochemistry Department

Dr. F. L. MITCHELL—assistance and expenses: metabolism of ^{19}C- and ^{21}C-labelled steroids in the foetus and new born infant. (180)

QUEEN'S COLLEGE, UNIVERSITY OF ST. ANDREWS

Anatomy Department

Professor R. E. COUPLAND—assistance and expenses: organ culture using high pressures of oxygen. (181)

Biochemistry Department

Dr. R. P. COOK—expenses (from special funds for the purchase of costly apparatus): chemistry and metabolism of cholesterol. (182)

Dr. G. J. DUTTON—assistance and expenses: mechanism and significance of extrahepatic glucuronide synthesis. (183)

Dr. D. A. STANSFIELD—expenses: mode of action of gonadotrophins on the corpus luteum and the function of ascorbic acid in the corpus luteum. (184)

Dr. J. TIBBS—(1) expenses: biochemical changes responsible for and accompanying motility in micro-organisms; (2) assistance: biological and structural changes associated with loss of motility and encystment in *Colpoda steinii*. (185)

Chemistry Department

Dr. R. FOSTER—assistance: charge transfer in drug action. (186)

Pharmacology and Therapeutics Department

Professor R. B. HUNTER—expenses: adrenal inhibitors. (187)

Dr. P. B. MARSHALL—assistance and expenses: relationship of histidine decarboxylase to other amino acid decarboxylases. (188)

Dr. D. M. SHEPHERD—assistance and expenses: hepatocarcinogenesis with diethylnitrosamine. (189)

Dr. I. H. STEVENSON—expenses: penicillin binding in *Staphylococcus aureus*. (190)

Physiology Department

Dr. J. T. HEMINGWAY—expenses: action of ascorbic acid on corticosteroid control of mitosis. (191)

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Psychiatry Department

Professor I. R. C. BATCHELOR—assistance: impaired selective attention and short-term memory in schizophrenia and organic cerebral disease. (192)

Dr. A. MCGHIE—assistance: clinical and experimental study of disturbances of attention and perception in schizophrenia. (193)

ROYAL INFIRMARY

University Department of Pathology

Dr. H. G. MORGAN—assistance and expenses: formation of calcium oxalate renal calculi in man. (194

Durham

UNIVERSITY

Psychology Department

Mrs. I. P. HOWARD—assistance and expenses: cyclofusion and stereoscopic vision. (195)

Zoology Department

Professor D. BARKER—assistance and expenses: innervation of skeletal muscle. (196)

Edinburgh

MEDICAL RESEARCH COUNCIL CLINICAL ENDOCRINOLOGY RESEARCH UNIT

Dr. W. I. CARD—assistance and expenses: immunological method for the assay of gastrin in tissues and body fluids. (197)

NORTHERN GENERAL HOSPITAL

Rheumatic Diseases Unit

Dr. J. J. R. DUTHIE—assistance and expenses: pathogenesis of rheumatoid arthritis. (198)

ROYAL EDINBURGH HOSPITAL

Dr. Elizabeth E. ROBERTSON and Dr. G. W. ASHCROFT—assistance: metabolic aspects of mental illness. (199)

ROYAL INFIRMARY

Therapeutics Department

Dr. W. J. IRVINE—expenses: the cytotoxic factor in thyroid disease. (200)

UNIVERSITY

Bacteriology Department

Dr. D. M. WEIR—assistance and expenses: high molecular weight immunoglobulins. (201)

Dr. J. F. WILKINSON—assistance: continuous culture of bacteria. (202)

Biochemistry Department

Dr. P. C. JOCELYN—expenses: inhibitory effect of vitamin B_{12} on the oxidation of glutathione in human erythrocytes and the role of serum copper on this oxidation. (203)

Dr. J. H. OTTAWAY—expenses: control of metabolism in muscle. (204)

Dr. L. G. PLASKETT—assistance and expenses: role of thyroglobulin in thyroid hormone biosynthesis. (205)

Chemistry Department

Dr. D. J. MANNERS—assistance and expenses: structure and metabolism of glycogen, with special reference to glycogen storage diseases. (206)

Child Life and Health Department

Dr. T. T. S. INGRAM—assistance and expenses: retarded speech development in children. (207)

Diagnostic Radiology Department

Dr. E. SAMUEL—assistance and expenses: potentialities of radiology as a means of estimating pulmonary function. (208)

Institute of Animal Genetics

Professor G. H. BEALE—assistance and expenses: genetic and biochemical studies of the antigens of *Paramecium*. (209)

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Dr. J. O. BISHOP—(1) expenses: gene-controlled specificity of protein synthesis; (2) expenses: specificity of protein synthesis. (210)

Dr. D. S. FALCONER—assistance and expenses: genetics of susceptibility of mice to induced pulmonary tumours. (211)

Medical Physics Department

Dr. J. R. GREENING—(1) assistance and expenses: an investigation of chemiluminescence; (2) assistance and expenses: dosimetry of low-voltage X-rays. (212)

Department of Medicine

Dr. A. DOIG—assistance and expenses: unilateral renal disease. (213)

Professor K. W. DONALD—assistance: blood gas tensions in respiratory insufficiency, and the use of oxygen as treatment. (214)

Orthopaedic Surgery Department

Professor J. I. P. JAMES—assistance and expenses: changes in the nature, structure and activity of bone and cartilage cells with age. (215)

Pathology Department

Professor G. L. MONTGOMERY—expenses: coronary arterial disease. (216)

Dr. H. G. MORGAN—assistance and expenses: formation of calcium oxalate renal calculi in man. (217)

Pharmacology Department

Dr. R. B. BARLOW—expenses: relationship between chemical structure and activity at acetylcholine receptors. (218)

Dr. B. L. GINSBORG—expenses: effects on synaptic transmission of the various ganglion-blocking agents. (219)

Professor W. L. M. PERRY—assistance and expenses: amino acid and amine metabolism in relation to mental illness. (220)

Psychological Medicine Department

Dr. I. OSWALD—expenses: studies of sleep and of allied spontaneous and induced alterations of consciousness. (221)

Physiology Department

Professor D. WHITTERIDGE—expenses (from special funds for the purchase of costly apparatus): electron microscope for ultra-high-resolution studies on cell structure (also for use by Anatomy and Bacteriology Departments and Institute of Animal Genetics). (222)

Respiratory Diseases and Tuberculosis Department

Professor J. W. CROFTON—assistance: transmural bronchial pressure. (223)

School of Dental Surgery

Mr. G. S. BEAGRIE—expenses: periodontal disease in the mouse. (Also in the Pathology Department.) (224)

Surgical Science Department (Experimental Programming Unit)

Dr. D. MICHIE—expenses: quantitative study of problem-solving behaviour. (225)

Therapeutics Department

Dr. I. W. DELAMORE—expenses: effect of iron deficiency upon gastric function. (226)

Professor R. H. GIRDWOOD—expenses: mucosal changes in intestinal malabsorption. (227)

Dr. E. A. HARRIS—expenses: chemical control of respiration. (228)

Zoology Department

Mrs. K. M. G. ADAM—assistance and expenses: DNA-mediated transformation of free-living amoebae. (229)

Dr. P. M. B. WALKER—assistance: microspectrophotometric study of RNA and DNA fractions at different stages of the growth and differentiation of single cells. (230)

Dr. P. M. B. WALKER and Dr. D. H. L. BISHOP—expenses (from special funds for the purchase of costly apparatus): (i) molecular hybridization in the study of nucleic acid affinities; (ii) the control of protein synthesis in a subcellular bacterial preparation. (231)

Student Expedition

Mr. P. J. HOGARTH—expenses: Edinburgh University Biological East Africa Expedition (from private funds at the Council's disposal). (232)

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Bacteriology Department

Professor J. W. McLeod—expenses: (i) thermostable toxin in staphylococcal infection; (ii) control of infection of the urinary tract. (233)

Gastro-Intestinal Unit

Dr. W. I. Card—assistance and expenses: action of gastrin on human gastric secretion. (234)

Dr. W. Sircus—expenses: investigation and care of alimentary disease: multiple analysis of records. (235)

Pathology Department

Dr. N. Maclean—expenses: chromosomal anomalies in normal and mentally retarded subjects. (236)

Elstree

LISTER INSTITUTE OF PREVENTIVE MEDICINE

Mr. A. F. B. Standfast—assistance: identification of the two immunizing antigens of *Bordetella pertussis.* (237)

Entebbe, Uganda

East African Virus Research Institute

Professor A. J. Haddow—expenses: development of special apparatus for use in research programmes being undertaken in the Institute. (238)

Epsom

Dr. E. J. C. Kendall—personal and expenses: acute respiratory infections occurring in a general practice population and among the boarders in a boys' school. (239)

Exeter

UNIVERSITY

Physics Department

Mr. K. P. S. Caldwell and Dr. F. C. Flack—assistance and expenses: control of rectal and urinary incontinence. (240)

Postgraduate Medical Institute

Dr. D. Mattingly—assistance and expenses: free 11-hydroxycorticoids in human plasma and urine. (241)

Psychology Department

Dr. R. Lynn—assistance and expenses: autonomic reactivity, orientation reactions and speed of habituation in children aged 0–15 years. (242)

Fajara, The Gambia

MEDICAL RESEARCH COUNCIL LABORATORIES

Mrs. M. E. Wilson—personal and expenses: the incidence of malaria. (243)

Glasgow

ROYAL INFIRMARY

Surgery Department

Professor W. A. Mackey—assistance and expenses: physiology of cerebral blood in relation to metabolism. (244)

ROYAL MENTAL HOSPITAL

Dr. T. Freeman—assistance and expenses: clinical and psychological investigation of psychotic reactions. (245)

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Anatomy Department

Dr. A. H. BAILLIE—assistance: 3, β-hydroxysteroid dehydrogenase activity. (246)

Biochemistry Department

Dr. R. M. S. SMELLIE—expenses: biosynthesis of RNA. (247)

Dr. W. H. HOLMS—assistance: adaptive enzyme synthesis in staphylococci. (248)

Dr. H. N. MUNRO—assistance and expenses: mode of action of dietary amino acids on adrenocortical function. (249)

Genetics Department

Dr. J. H. RENWICK—assistance and expenses: the sequence of gene loci in man. (250)

Department of Medicine

Dr. A. S. DOUGLAS—(1) assistance and expenses: thrombolytic therapy and fibrinolytic states; (2) assistance: (i) MRC trial of anticoagulant therapy in acute myocardial infarction; (ii) fibrinolysis. (251)

Pathology Department

Professor T. SYMINGTON—assistance and expenses: densitometric and electron microscope appearances of tissue cultures of the adrenal. (252)

Institute of Physiology

Dr. I. A. BOYD—expenses: (i) muscle spindle as a transducer; (ii) release of acetylcholine in skeletal muscle. (Also at the Boyd Medical Research Institute.) (253)

Dr. J. V. G. A. DURNIN—assistance and expenses: investigation of the diets of pre-school children in the Glasgow area. (254)

Dr. J. S. GILLESPIE—assistance: possible re-incorporation of adrenergic transmitter into postganglionic nerve endings. (255)

Mr. J. J. LEWIS—expenses: interrelationships between blood pH and electrolyte levels and alveolar gas tensions. (Also in Experimental Pharmacology Department.) (256)

Psychology Department

Professor R. W. PICKFORD—expenses: colour vision. (257)

Department of Steroid Biochemistry

Dr. J. K. GRANT—assistance and expenses: secretion and metabolism of testosterone in normal and virilized subjects. (258)

Surgery Department

Mr. K. BLOOR—expenses (from special funds for the purchase of costly apparatus): (i) treatment of cerebrovascular disease; (ii) development of collateral circulation. (Also at Western Infirmary.) (259)

Professor Sir Charles ILLINGWORTH—assistance: carbon monoxide poisoning. (260)

Wellcome Laboratory, Veterinary Hospital

Mr. A. C. FORRESTER—expenses: intracranial tension during anaesthesia. (Also at Glasgow and West of Scotland Neurosurgical Unit, Killearn Hospital.) (261)

Professor W. A. MACKEY—assistance and expenses: autoregulation of the flow of blood in the skin and renal cortex investigated by methods depending on the rate of clearance of radioactive ' inert ' gases. (262)

Zoology Department

Mr. S. A. BARNETT—assistance: physiology of social stress in wild rats. (263)

WESTERN INFIRMARY

Department of Medicine

Dr. A. GOLDBERG—assistance and expenses: (i) measurement of the haem enzymes of human marrow erythropoietic cells in various blood diseases; (ii) studies in iron absorption. (264)

Dr. B. E. C. NORDIN—assistance: investigation of the solubility of bone salts and extension of techniques employed to the study of the physical chemistry of renal stones. (265)

Professor E. J. WAYNE—assistance: iodine metabolism in health and disease. (266)

University Department of Orthopaedic Surgery

Professor Roland BARNES—expenses: prospective survey of intracapsular fractures of the neck of the femur. (267)

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Applied Microbiology and Biology Department

Dr. J. A. BLAIN—assistance and expenses: oxidizability of unsaturated plasma lipids. (268)

Pharmacy Department

Dr. Mary DAWSON—expenses: antibacterial substances of animal origin. (269)

Dr. N. G. WATON—expenses: histamine formation in mammals. (270)

Radiation Laboratory

Dr. A. WARD—(1) expenses: measurements of extremely small amounts of radioisotopes in blood and urine; (2) expenses: physical differences which distinguish cancer cells and normal cells. (271)

Harlow

INDUSTRIAL HEALTH CENTRE

Lord TAYLOR—expenses: (i) health of higher executives; (ii) mental health in Harlow. (272)

Hull

UNIVERSITY

Biochemistry Department

Dr. G. W. CROSBIE—(1) expenses: pyrimidine biosynthesis investigated by means of radioactive compounds; (2) assistance: glycine and glyoxylate metabolism in micro-organisms. (273)

Professor E. A. DAWES—(1) assistance and expenses: diauxic growth effect in *Pseudomonas aeruginosa*; (2) assistance and expenses: role of poly-β-hydroxybutyrate in the genus *Azotobacter* with reference to endogenous metabolism and survival. (274)

Dr. D. W. RIBBONS—assistance and expenses: relationship of endogenous metabolism to bacterial survival. (275)

Psychology Department

Professor A. D. B. CLARKE—assistance: abstraction processes in thinking. (276)

Ibadan, Western Nigeria

UNIVERSITY COLLEGE

Chemical Pathology Department

Dr. J. C. EDOZIEN—assistance and expenses: biochemical studies in kwashiorkor. (277)

Physiology Department

Professor J. GRAYSON—expenses: the use of internal calorimetry in the determination of blood flow in solid organs. (278)

Ibstock

Dr. C. A. H. WATTS—expenses: depressive disorders in general practice. (279)

Ilford

GOODMAYES HOSPITAL

Dr. H. R. A. TOWNSEND—expenses: computer analysis of EEG records. (280)

Kampala, Uganda

MAKERERE UNIVERSITY COLLEGE

Pharmacology Department

Mr. J. A. LOCK—expenses: isolation, characterization and pharmacology of materials from *Bersama abyssinica* var. *paullinoides*. (281)

Physiology Department

Dr. P. G. WRIGHT—expenses: peripheral circulation in the monkey. (282)

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Keele

UNIVERSITY

Department of Communication

Professor D. M. MACKAY—(1) assistance and expenses: brain lesions in relation to anomalous visual responses (in association with Dr. Eliot Slater, National Hospital for Nervous Diseases, Queen Square, London); (2) assistance and expenses: mechanisms of motion perception in the human visual and cutaneous nervous systems. (283)

Kingston, Jamaica

UNIVERSITY OF THE WEST INDIES

Biochemistry Department

Dr. C. Von HOLT—assistance and expenses: degradation of leucine in protein-deficient rats. (284)

Morbid Anatomy Department

Dr. J. A. HAYES—expenses: relationship of emphysema to pulmonary vasculature and pulmonary heart disease in Jamaica. (285)

UNIVERSITY HOSPITAL

Dr. Pamela E. B. RODGERS—personal and expenses: electrophoretic studies on Jamaican patients with neuropathy. (286)

Kumi, Uganda

KUMI LEPROSY CENTRE

Dr. J. A. KINNEAR BROWN—personal and expenses: trial of BCG in leprosy. (287)

Leeds

GENERAL INFIRMARY

Electroencephalography Department

Dr. K. A. EXLEY—expenses: effects of cerebral lesions in man upon cortical electrical responses evoked by sensory stimuli. (288)

Electromyography Department

Dr. D. TAVERNER—expenses: electrophysiological study of the peripheral neuromuscular system in patients with renal failure. (289)

Renal Research Unit

Dr. F. M. PARSONS—(1) expenses: investigation to compare and contrast the effect of natural protein feeding with a mixture of essential amino acids; (2) assistance and expenses: cadaveric renal transplantation. (Also in the University Chemical Pathology Department.) (290)

Thoracic Surgery Department

Mr. G. H. WOOLER—expenses: (i) combination of hypothermia with extracorporeal circulation for open cardiac surgery; (ii) measurement of coronary blood flow. (291)

Urology Department

Mr. M. FOX—personal and expenses: some basic immunological and cellular problems of homotransplantation. (292)

UNIVERSITY

Anaesthetics Department

Professor J. F. NUNN—assistance and expenses: arterial and tissue hypoxia during anaesthesia and surgery (formerly at Royal College of Surgeons, London). (293)

Anatomy Department

Dr. Julia M. FOURMAN—personal and expenses: water conservation by the kidney. (294)

Bacteriology Department

Dr. J. G. SHOESMITH—assistance and expenses: effects of heat and radiation on tetanus spores. (295)

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Biochemistry Department

Dr. F. W. CHATTAWAY—(1) assistance and expenses: mode of inhibition of growth of fungi by certain steroids; (2) assistance and expenses: factors affecting growth and morphology of pathogenic fungi. (296)

Professor S. DAGLEY—assistance: effect of antibiotics on bacterial cell constituents. (297)

Chemical Pathology Department

Professor P. FOURMAN—assistance: osteomalacia after gastrectomy. (298)

Professor G. H. LATHE—expenses: mechanisms of bile secretion. (299)

Dr. S. R. STITCH—(1) assistance and expenses: biosynthesis of oestrogen by the ovary after sterilization with X-irradiation; (2) expenses (partly from special funds for the purchase of costly equipment): investigation of ovarian and extra-ovarian oestrogens; (3) assistance: mechanism and locus of action of gonadotrophic hormones in the control of steroid biosynthesis by the ovary. (300)

Dr. C. TOOTHILL—assistance and expenses: haem synthetase in normal subjects and patients with familial hypochromic microcytic anaemia. (301)

Experimental Pathology and Cancer Research Department

Professor H. N. GREEN—assistance and expenses: biological testing of mineral oil fractions (on behalf of the Committee on the Carcinogenic Action of Mineral Oils). (302)

Dr. J. O. LAWS—expenses: action of chemical carcinogens on organ cultures of human foetal lung. (303)

Medical Physics Department

Dr. J. B. DAWSON—expenses: development of spectrochemical techniques for the study of mineral metabolism. (Also at the General Infirmary.) (304)

Mr. G. W. REED—assistance and expenses: quantitative histology of cortical bone. (305)

Professor F. W. SPIERS—assistance: development of physical techniques for the measurement of stable iodine in biological media. (306)

Department of Medicine

Dr. M. S. LOSOWSKY—expenses: lipid metabolism in acute renal failure. (Also at Leeds General Infirmary.) (307)

Dr. G. A. ROSE—assistance and expenses: metabolic bone diseases. (Also at Leeds General Infirmary.) (308)

Pathology Department

Professor C. E. LUMSDEN—assistance and expenses: immunological studies in experimental allergic encephalitis and in human disseminated sclerosis. (309)

Physiology Department

Professor A. HEMINGWAY and Dr. R. J. LINDEN—assistance and expenses: basic physiology of cardiovascular system. (310)

Dr. W. J. O'CONNOR—assistance and expenses: water and sodium balance in dogs. (311)

School of Dentistry (Oral Biology Unit)

Dr. S. M. WEIDMANN—assistance and expenses: the mechanism of calcification. (312)

Zoology Department

Professor J. M. DODD—assistance and expenses: (i) comparative studies on goitrogenesis; (ii) bioassay of thyroid-stimulating hormone and thyroid hormones in micro-amounts of body fluids and pituitary fractions. (313)

Leicester

UNIVERSITY

Biochemistry Department

Professor H. L. KORNBERG—assistance: microbial metabolism of analogues of intermediates of the tricarboxylic acid cycle. (314)

Engineering Department

Dr. J. M. NIGHTINGALE—assistance and expenses: automatic upper-arm prosthesis. (315)

Psychology Department

Dr. D. R. DAVIES—expenses: effects of visual stimuli on some psychophysiological parameters. (316)

Zoology Department

Dr. D. M. GUTHRIE—expenses: physiology of regenerating nerve fibres in insects. (317)

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Lincoln

ST. GEORGE'S HOSPITAL

Biochemical Laboratory

Dr. L. NAFTALIN—expenses: changes in aminoaciduria after therapeutic irradiation. (318)

Liverpool

UNIVERSITY

Building Science Department

Dr. M. E. BRYAN—assistance and expenses: middle ear reflex. (319)

Dermatology Department

Dr. C. F. H. VICKERS—personal and expenses: epidermal reservoir phenomenon. (320)

Materia Medica, Pharmacy, Pharmacology and General Therapeutics Department

Professor A. WILSON—(1) assistance and expenses: metabolism and excretion of neostigmine; (2) expenses (from special funds for the purchase of costly apparatus): metabolism and excretion of neostigmine and pyridostigmine. (321)

Obstetrics and Gynaecology and Physiology Departments

Dr. V. R. TINDALL—assistance and expenses: liver function and blood flow at different stages of normal and abnormal pregnancy, and at various stages in the menstrual cycle of non-pregnant women. (322)

Organic Chemistry Department

Professor A. L. BATTERSBY—assistance: structure of the alkaloids of *Strychnostoxifera.* (323)

School of Dental Surgery

Professor R. L. HARTLES—expenses: experimental dental caries in the rat. (324)

School of Tropical Medicine

Professor B. G. MAEGRAITH—(1) assistance and expenses: electron microscopy of liver lesions in experimental malaria; (2) assistance and expenses: effect of malarial and other protozoal infections on the enzymes of tissue and mitochondria. (325)

Surgery Department

Mr. J. G. GOW—expenses: effect of gastric hypothermia on acute haematemesis. (Also at Sefton General Hospital.) (326)

WALTON HOSPITAL

Laryngology Department

Mr. A. TUMARKIN—expenses: speech transmission systems (partly from Alexander Pigott Wernher Memorial Trust Funds). (327)

London

ATKINSON MORLEY'S HOSPITAL

Research Laboratories

Dr. Helen M. B. BUCKELL—personal, assistance and expenses: metabolic studies in neurosurgical patients. (328)

BATTERSEA COLLEGE OF TECHNOLOGY

Department of Metallurgy and Materials Technology

Professor L. W. DERRY—assistance and expenses: corrosion of surgical implants. (329)

BEDFORD COLLEGE

Chemistry Department

Dr. Margaret E. FARAGO—assistance and expenses: metal ions and transamination reactions. (330)

Physiology and Biochemistry Department

Mr. G. H. WRIGHT—assistance: water and electrolyte transport across foetal gastric mucosa. (331)

Psychology Department

Dr. Monica LAWLOR—expenses: activity patterns in the golden hamster. (332)

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Chemistry Department

Dr. B. CAPON—assistance and expenses: intramolecular catalysis in glycoside hydrolysis. (333)

Crystallography Laboratory

Professor J. D. BERNAL—assistance and expenses: X-ray diffraction studies on turnip yellow mosaic virus and heavy-atom derivatives. (334)

Psychology Department

Professor A. SUMMERFIELD—expenses: physiological basis of behaviour. (335)

Mr. B. M. FOSS—assistance and expenses: effect of signal strength on time taken to detect and localize auditory stimuli. (336)

BRITISH GELATINE AND GLUE RESEARCH ASSOCIATION

Dr. D. A. SUTTON—assistance and expenses: structure and behaviour of collagen. (337)

CENTRAL MIDDLESEX HOSPITAL

Departments of Cardiology and Thoracic Surgery

Dr. K. P. BALL—assistance and expenses: clinical trial of diet in coronary thrombosis (with Professor J. N. Morris). (338)

Dr. K. P. BALL and Dr. H. JOULES—assistance and expenses: management of respiratory failure in chest and other diseases. (Also at the Pulmonary Physiology Unit, Hammersmith Hospital.) (339)

Gastroenterology Department

Dr. F. AVERY JONES—(1) assistance: peptic ulceration; (2) assistance: (i) genetic studies in ulcerative procto-colitis and Crohlin's disease; (ii) maintenance treatment of patients with procto-colitis after successful treatment of an acute attack. (340)

Dr. Margot SHINER—personal: development of the technique of small intestine biopsy. (341)

CHARING CROSS HOSPITAL MEDICAL SCHOOL

Anatomy Department

Dr. T. W. GLENISTER—assistance and expenses: biology of implanting mammalian blastocysts. (Also at the Electron Microscope Unit, West London Hospital.) (342)

Bacteriology Department

Dr. H. I. WINNER—assistance and expenses: pathogenic mechanisms of yeast-like fungi with particular reference to the genus *Candida*. (343)

Chemical Pathology Department

Dr. J. SPENCER-PEET—expenses: relationship between deficiency of glycogen synthetase and the occurrence of hypoglycaemia in man. (344)

Department of Medicine

Dr. K. D. BAGSHAWE—assistance and expenses: trophoblastic tumours. (345)

Professor H. E. DE WARDENER—assistance and expenses: presence of synalbumin antagonism in the relatives of diabetics and others. (346)

Pharmacology Department

Dr. J. B. E. BAKER—assistance and expenses: influence of drugs on the isolated myocardium subjected to varying degrees of asphyxia. (347)

CHELSEA COLLEGE OF SCIENCE AND TECHNOLOGY

Chemistry Department

Dr. D. F. EVERED—(1) assistance and expenses: amino acid uptake in various animal tissues; (2) expenses: (i) ornithine cycle enzymes; (ii) amino acids of human tissues. (348)

Dr. A. M. JAMES—(1) assistance and expenses: ionizable surface groups and their relationship to known antigens in staphylococci (also at Central Public Health Laboratory, Colindale); (2) assistance and expenses: lipid material in the cell walls of various strains of streptococci. (349)

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Anaesthetics Department

Dr. J. M. HALL—personal: development of non-explosive anaesthetic agents (in collaboration with Dr. T. H. S. Burns, St. Thomas's Hospital). (350)

Handicapped Children's Centre, Newcomen House

Dr. Mary D. H. SHERIDAN—personal and expenses: developmental tests for infants and young children with special reference to visual and language disorders. (351)

GUY'S HOSPITAL MEDICAL SCHOOL

Anatomy Department

Dr. M. BROOKES—expenses: vascularization of bone. (352)

Bacteriology Department

Dr. R. H. GORRILL—assistance: experimental bacillary pyelonephritis. (353)

Professor R. KNOX—expenses: work on steam pressure sterilizers (on behalf of the Council's Working Party on Steam Pressure Sterilizers). (354)

Biochemistry and Chemistry Department

Dr. A. N. DAVISON—assistance and expenses: lipid and protein metabolism in disseminated sclerosis. (355)

Dr. D. B. GOWER—expenses: biosynthesis of androst-16-en-3α-ol and other 3-hydroxy-Δ-16 steroids. (356)

Professor G. A. D. HASLEWOOD—expenses: adrenocortical activity in depressive illness. (357)

Chemical Pathology Department

Professor R. H. S. THOMPSON—(1) assistance and expenses: action of lysolecithin and phospholipase A on the nervous system; (2) expenses: certain biochemical disturbances in neurological disorders. (358)

Experimental Medicine Department

Dr. R. T. GRANT—personal and expenses: blood circulation in skeletal muscle. (359)

Department of Medicine

Professor W. J. H. BUTTERFIELD—assistance and expenses: metabolism of isolated mammalian islets of Langerhans. (360)

Pathology Department

Dr. J. N. BLAU—personal and expenses: (i) blood thymus barrier to radioactive-labelled proteins, vital dyes and antigens; (ii) relationship of lymphocytes and germinal centres. (361)

Dr. J. B. CAVANAGH—assistance and expenses: experimental peripheral nerve studies. (362)

Paediatric Research Unit

Professor P. E. POLANI and Dr. J. A. FRASER ROBERTS—assistance and expenses: autosomal anomalies and some hereditary defects in a population sample. (363)

Pharmacology Department

Dr. J. A. NISSIM—assistance and expenses: pharmacological inhibition and stimulation of intestinal absorption. (364)

Professor J. M. ROBSON—(1) assistance and expenses: analgesic properties of anaesthetic agents; (2) expenses (from special funds for the purchase of costly apparatus): 5-hydroxytryptamine in blood in pregnancy; (3) assistance: effect of drugs on pregnancy; (4) assistance and expenses: *in vivo* and *in vitro* action of drugs and of immune mechanisms on the multiplication of *Mycobacterium leprae.* (365)

Physics Department

Professor C. B. ALLSOPP—expenses: production of low temperatures by semi-conductor thermoelectric methods, with particular reference to their applications to surgery. (366)

Surgery Department

Dr. F. G. ELLIS—expenses: bladder motility. (367)

Student Expedition

Mr. I. R. BISHOP—expenses (from private funds at the Council's disposal): expedition to the lower Amazon area by members of Guy's Hospital Medical School and the London School of Hygiene and Tropical Medicine. (368)

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HAMMERSMITH HOSPITAL

Dr. Patricia E. MORTIMER—personal: family study of coeliac disease. (Also at the Queen Elizabeth Hospital for Children, Hackney.) (369)

Microbial Genetics Research Unit

Dr. E. W. MEYNELL—personal: participation in the Unit's programme, with particular reference to work on resistance-transfer factors. (370)

Physics Department

Professor J. R. MALLARD—assistance and expenses: development of improved quantitative scanning techniques for radioisotope localization. (371)

Dr. R. MORRISON and Professor J. R. MALLARD—expenses: *in vivo* technique for studying hormone dependence of tumour growth. (372)

Dr. R. MORRISON—expenses: analysis of the results of treatment of malignant disease by the Council's 8-MeV linear accelerator. (373)

THE HOSPITAL FOR SICK CHILDREN

Chemical Pathology Department

Dr. Barbara E. CLAYTON and Dr. J. M. TANNER—expenses: growth hormone in children. (374)

EEG and Clinical Neurophysiology Department

Dr. G. PAMPIGLIONE—expenses: electroencephalograms of children before and after measles. (375)

Morbid Anatomy Department

The late Dr. M. BODIAN—expenses: chromosome studies in neoplastic and other conditions. (376)

IMPERIAL CANCER RESEARCH FUND

Division of Experimental Biology

Dr. G. F. MARRIAN—assistance: differences in biological properties of avian tumour viruses. (377)

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

Chemistry Department

Dr. Margaret GOODGAME—assistance and expenses: complexes of substituted benzimidazoles with metal ions. (378)

Physics Department

Dr. W. T. WELFORD—assistance: Mach effects on microscopical vision. (379)

INSTITUTE OF CANCER RESEARCH

Chester Beatty Research Institute

Dr. P. ALEXANDER—(1) assistance and expenses: susceptibility of cells to ionizing radiations (also at Botany Department, Imperial College); (2) expenses: effect of immunological procedures on radiosensitivity of tumours. (380)

Professor F. BERGEL—expenses (from special funds for the purchase of costly apparatus): universal source for spectrographic analysis. (Also at the Royal Marsden Hospital.) (381)

Dr. R. C. BRAY—(1) assistance and expenses: isolation of milk xanthine oxidase in a state suitable for physical studies; (2) expenses: mechanism of action of xanthine oxidase studied by electron-spin resonance. (Also at Imperial College of Science and Technology, Inorganic Chemistry Department.) (382)

Professor J. A. V. BUTLER—(1) assistance and expenses: multiplication of bacteriophage $\phi X174$; (2) expenses (from special funds for the purchase of costly apparatus): nucleic acid biosynthesis in bacteria and in virus-infected cells. (383)

Dr. R. A. M. CASE—expenses: cohort studies of mortality from various diseases in the British Isles. (384)

Dr. K. S. KIRBY—(1) assistance: methods of separating DNA and RNA from the same tissue; (2) expenses: isolation and fractionation of DNA and RNA from *B. subtilis* and *E. coli*. (385)

Professor P. C. KOLLER—assistance and expenses: role of chromosomes in carcinogenesis. (386)

Dr. Edna M. F. ROE and Dr. R. LUMLEY JONES—expenses: infrared studies on DNA. (387)

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Dr. F. J. C. ROE—assistance and expenses: carcinogenicity of combinations of cigarette smoke condensate and air pollutants and related problems, including the effects of thymectomy. (388)

Physics Department

Professor L. F. LAMERTON—expenses: provision of automatic radioisotope counting equipment at the Surrey Branch of the Institute. (389)

INSTITUTE OF CHILD HEALTH

Growth and Development Department

Dr. J. M. TANNER—(1) expenses: steroid excretion and physique in adults and children; (2) assistance and expenses: development of adrenal function in children. (390)

Haematology Department

Dr. R. M. HARDISTY—(1) expenses: blood coagulation; (2) expenses: acute leukaemia in children; (3) expenses: chromosomal abnormalities in leukaemia and other neoplastic diseases of childhood. (391)

INSTITUTE OF DENTAL SURGERY

Mr. A. S. T. FRANKS—personal: temporomandibular joint studies. (392)

Pathology Department

Professor I. R. H. KRAMER—expenses: behaviour of osteoclasts and other forms of multinucleate giant cells. (393)

INSTITUTE OF DERMATOLOGY

Professor C. D. CALNAN—assistance and expenses: effect of antimalarial and other substances and of ultraviolet light on the porphyrin metabolism of humans and animals. (394)

Dr. I. A. MAGNUS—(1) assistance and expenses: photosensitivity of skin; (2) expenses: phosphate esters in psoriatic skin. (395)

Dr. Elizabeth A. RYAN—personal and expenses: degenerative changes in human skin. (396)

Dr. I. SARKANY—personal and expenses: effect of griseofulvin on the pathogenesis of dermatophytoses. (397)

Dr. S. SHUSTER—(1) expenses: factors influencing senile purpura and corticosteroid purpura; (2) assistance and expenses: internal manifestations of cutaneous disease. (398)

Dr. G. C. WELLS—assistance: mitotic indices in human skin. (399)

INSTITUTE OF DISEASES OF THE CHEST

Dr. Lynne M. REID—(1) expenses: certain aspects of mucus secretion in the bronchial tree; (2) assistance: intracellular changes associated with mucus secretion. (400)

Biochemistry Department

Dr. I. S. LONGMUIR—assistance and expenses: transport of oxygen in the tissues. (401)

INSTITUTE OF LARYNGOLOGY AND OTOLOGY

Dr. R. HINCHCLIFFE—expenses: (i) clinical investigation of vertigo; (ii) bioelectric potentials in the cochlea of the cat. (402)

INSTITUTE OF NEUROLOGY

Dr. L. J. HERBERG—assistance and expenses: neurological basis of motivation. (403)

Chemical Pathology Department

Professor J. N. CUMINGS—expenses: study of post-mortem material in chronic neurological disease. (404)

Dr. G. CURZON—assistance and expenses: aromatic amine metabolism in the brain. (405)

Clinical Neurology Department

Professor R. W. GILLIATT—(1) assistance and expenses: neurological disorders produced experimentally in animals by toxic substances; (2) assistance and expenses: motor-unit innervation ratios in fore-limb muscles in primates. (406)

Dr. T. A. SEARS—expenses (partly from special funds for the purchase of costly apparatus): nervous mechanism of respiration. (407)

Neuropathology Department

Dr. T. G. SCOTT—assistance: microanatomical localization in cerebellar cortex. (408)

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Professor J. C. McClure BROWNE—assistance and expenses: oxytocic lipids in human amniotic fluid. (409)

Professor S. G. CLAYTON and Dr. I. F. SOMMERVILLE—assistance and expenses: human ovarian function in dysfunctional uterine haemorrhage. (410)

Dr. Rosalinde HURLEY—expenses: pathogenicity of commensal species of the genus *Candida*, their role in infection of the vagina in the human, and certain methods of treatment of vaginal moniliasis. (411)

Mr. W. G. MACGREGOR—assistance and expenses: measurement of peripheral blood flows in normal pregnancy and the puerperium. (412)

Professor J. H. M. PINKERTON—assistance: normal and abnormal ovarian function in the human. (413)

Dr. M. SANDLER—(1) assistance: investigation of 5-hydroxyindole metabolism in the laboratory animal; (2) expenses: urinary excretion of biologically active amines in pregnancy. (414)

INSTITUTE OF OPHTHALMOLOGY

Dr. G. B. ARDEN—expenses: analysis of retinal activity. (415)

Professor N. ASHTON—assistance and expenses: hypertensive retinopathy. (416)

Sir Stewart DUKE-ELDER—assistance and expenses: investigation of the potentialities of lasers in ophthalmology. (417)

INSTITUTE OF ORTHOPAEDICS

Dr. C. H. LACK—assistance and expenses: 'thrombolysometers' in the diagnosis and treatment of thrombosis. (418)

Dr. J. T. SCALES—assistance and expenses: 'levitation' in the treatment of large-area burns. (419)

Professor Sir Herbert SEDDON—expenses: evaluation of treatment of osteogenic sarcoma of the femur and tibia (on behalf of the Council's Working Party on Bone Sarcoma). (420)

INSTITUTE OF PSYCHIATRY

Biochemistry Department

Dr. D. B. GAMMACK—assistance and expenses: chemical investigation of cerebral constituents. (421)

Professor H. MCILWAIN—assistance and expenses: chemical contributions to electrical studies of the mammalian brain. (422)

Experimental Neurology Department

Professor G. D. DAWSON—(1) assistance: control of transmission in the sensory pathways through the thalamus; (2) assistance: alterations of functional and anatomical organization in the cerebral cortex associated with epileptogenic lesions; (3) expenses: cerebral electrical activity in animals; (4) assistance: effect of epileptogenic lesions and ablations of the brain on complex behaviour in the monkey. (423)

Neuroendocrinology Department

Professor J. T. EAYRS—assistance and expenses: cerebral mechanisms involved in assembling information from sensory channels. (424)

Neuropathology Department

Dr. L. W. DUCHEN—(1) personal and expenses: changes in the pituitary gland after pituitary stalk section; (2) expenses: cellular proliferation in the neurohypophysis. (425)

Physiology Department

Dr. H. J. CAMPBELL—expenses: determination of the extrahypothalamic regions of the central nervous system involved in anterior pituitary responses to emotional stress. (426)

Psychiatry Department

Professor Sir Aubrey LEWIS—assistance and expenses: comparative trial of conditioning treatment of neuroses. (427)

Dr. E. MARLEY—assistance and expenses: release of sympathins by stimulation of the peripheral and central nervous system and their effect on the central nervous system. (428)

Dr. R. P. MICHAEL—(1) expenses: action of hormones on the activity of the brain; (2) assistance: investigation of the mechanisms underlying the expression of sexual behaviour in the female primate; (3) assistance and expenses: microtelemetry in experimental studies of sexual behaviour and the action of hormones. (429)

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Psychology Department

Professor H. J. EYSENCK—(1) assistance and expenses: structure of mental ability; (2) assistance and expenses: conditioning and personality. (430)

Dr. G. W. GRANGER—expenses: effect of alcohol on human visual thresholds. (431)

Dr. P. SLATER—(1) assistance and expenses: standardization and revalidation of the Sutton Booklet and the Selective Vocabulary Test; (2) expenses: development of a service for analysing repertory grids by computer. (432)

INSTITUTE OF UROLOGY

Mr. J. D. FERGUSSON—assistance and expenses: possible relationship between 'endemic', or primary, bladder stones and malnutrition. (433)

KING'S COLLEGE

Anatomy Department

Dr. R. M. H. MCMINN—expenses: functional cytology of intestinal absorption and malabsorption. (434)

Physiology Department

Dr. Gerta HILTON—personal, and expenses: role of the motoneurone in the determination of functional properties of skeletal muscle. (435)

Zoology Department

Dr. E. A. BARNARD—assistance and expenses: structure and function of deoxyribonucleoprotein and the roles of particular amino acid groups therein. (436)

KING'S COLLEGE HOSPITAL MEDICAL SCHOOL

Bacteriology Department

Miss B. M. PARTRIDGE—personal and expenses: *in vivo* studies of pathogenic fungi. (437)

Chemical Pathology Department

Professor C. H. GRAY—(1) expenses: metabolism of cortisol; (2) assistance: metabolism of steroids in disease; (3) assistance: bile pigment metabolism; (4) assistance and expenses: biochemical abnormality in acute intermittent porphyria. (438)

Clinical Pathology Department

Professor W. M. DAVIDSON—assistance and expenses: nuclear sex and human chromosomal abnormalities and their relation to various developmental abnormalities. (439)

Medical Physics Department

Dr. S. B. OSBORN and Professor J. F. FOWLER—expenses: radiation dose to bone from ^{22}Na. (440)

Medical Unit

Dr. J. ANDERSON—expenses: sodium transport. (441)

Department of Medicine and Diabetic Unit

Dr. K. W. TAYLOR—personal and expenses: insulin synthesis and secretion in normal and diabetic human serum. (442)

Pathology Department

Dr. Una M. KROLL—expenses: aetiology and recurrence rate of cervical erosion and its relationship to carcinoma. (443)

Surgical Unit

Professor J. G. MURRAY—assistance and expenses: stomach emptying after pyloroplasty. (444)

LEWISHAM GENERAL HOSPITAL

Dr. J. S. STAFFURTH—personal and expenses: plasma volume and total body-water in various conditions. (445)

LISTER INSTITUTE OF PREVENTIVE MEDICINE

Dr. J. M. CREETH—assistance: physico-chemical studies of blood group substances and their derivatives. (446)

Professor W. T. J. MORGAN—assistance and expenses: chemical basis of blood group specificity in man. (447)

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Dr. B. A. D. STOCKER—assistance: genetics of virulence in *Salmonella.* (448)

Dr. Winifred M. WATKINS—assistance and expenses: enzymic decomposition of blood group specific substances. (449)

Dr. W. J. WHELAN—(1) assistance and expenses: action of certain rabbit muscle enzymes and the synthesis of haptens and inhibitors in the dextran-antidextran system; (2) assistance and expenses: the glycogen-debranching enzyme system in rabbit muscle. (450)

LONDON HOSPITAL

Dr. D. G. PENINGTON—(1) personal, and expenses: methods for preparation of erythropoietin and studies of the factors governing its secretion in animals and in man; (2) assistance and expenses: aetiology of idiopathic thrombocytopenic purpura. (451)

Physiology Department

Mr. A. G. PARKS—assistance: *in vitro* study of the physiology and pharmacology of the human colon. (Also at the Research Department, St. Mark's Hospital.) (452)

LONDON HOSPITAL MEDICAL COLLEGE

Bacteriology Department

Professor C. F. BARWELL—assistance: antigenic differences between various strains of trachoma virus. (453)

Dr. C. S. CUMMINS—assistance and expenses: cell wall polysaccharide antigens in gram-positive bacteria. (454)

Bernhard Baron Institute of Pathology

Dr. D. O. HOURIHANE—expenses: asbestosis and mesotheliomas of the pleura and peritoneum. (455)

Dental Anatomy Department

Dr. R. W. FEARNHEAD—assistance and expenses: X-ray probe microanalysis of tooth enamel. (456)

Dental Pathology Department

Professor A. E. W. MILES—(1) assistance and expenses: ultrastructure of human amelogenesis and early enamel lesions; (2) assistance: pigmented enamel of various vertebrates. (457)

Dental School

Professor G. L. SLACK—(1) expenses: bacteriology of dental disease; (2) assistance and expenses: metabolism of oral filamentous organisms. (458)

Forensic Medicine Department

Dr. Barbara E. DODD—assistance: detection of blood group substances in stains from body fluids and other body products. (459)

Pharmacology Department

Professor M. WEATHERALL—assistance and expenses: effectiveness of various therapeutic procedures. (460)

Physiology Department

Dr. K. B. ROBERTS—expenses: studies on human leucocytes. (461)

Dr. R. L. SPEIRS—expenses: relation between the chemical composition of teeth and resistance to caries. (462)

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

Psychology Department

Dr. Hilde T. HIMMELWEIT—assistance and expenses: anxieties and tensions in children. (463)

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

Professor D. S. BERTRAM and Dr. W. E. ORMEROD—expenses: *Toxoplasma* infections of humans. (464)

Dr. J. O. IRWIN—personal: (i) theory of discrete distributions and its application to biometry; (ii) statistics of carcinogenic action of mineral oils. (465)

Applied Physiology Department

Dr. M. L. THOMSON—(1) assistance and expenses: human lung function in the home and in industry; (2) assistance and expenses: prospective study of asbestosis. (Also at Cape Asbestos Factory, Barking.) (466)

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Bacteriology and Immunology Department

Professor F. FULTON—expenses: tissue culture on polythene. (467)

Dr. I. G. MURRAY—assistance and expenses: mycetoma. (468)

Medical Statistics and Epidemiology Department

Professor P. ARMITAGE—assistance and expenses: statistical analysis of the results of clinical trials with γ-globulin conducted by the Council's Working Party on Hypogammaglobulinaemia. (469)

Dr. G. A. ROSE—expenses: the use of steroids in the nephrotic syndrome in adults. (470)

Occupational Health Unit

Professor R. S. F. SCHILLING—(1) assistance and expenses: prospective clinical, physiological and environmental survey of cotton-mill workers for the study of byssinosis; (2) assistance and expenses: (i) mortality of cohorts of workers at Cape Asbestos Factory, Barking; (ii) asbestos exposure in patients diagnosed as suffering from mesothelioma. (471)

Parasitology Department

Dr. J. D. FULTON—personal and expenses: (i) development of new tests for antibodies to *Toxoplasma*; (ii) preparation of vaccine for malaria. (472)

Dr. W. E. ORMEROD—assistance and expenses: protein metabolism of the malarial parasite. (473)

MAIDA VALE HOSPITAL

Electron Microscope Laboratory

Dr. P. K. THOMAS—assistance and expenses: electron microscope study of experimental allergic neuritis. (474)

Neurosurgical Unit

Mr. V. LOGUE—(1) assistance and expenses: analysis of disorders of motor skill in patients with cerebral lesions; (2) assistance: mental functions of the human optic thalamus. (Also at the Middlesex Hospital.) (475)

Pathological Department

Dr. W. H. MCMENEMEY—(1) assistance and expenses: presenile dementias; (2) assistance and expenses: comparison between the protein fractions of the cerebrospinal fluid and those in the blood. (476)

MIDDLESEX HOSPITAL MEDICAL SCHOOL

Academic Department of Psychiatry

Dr. J. M. HINTON and Dr. V. MEYER—assistance and expenses (from private funds at the Council's disposal): clinical tests of the sensorium in psychiatric patients. (477)

Dr. V. MEYER—assistance and expenses: control of stammering. (478)

Anatomy Department

Dr. J. G. BEARN—expenses: (i) foetal endocrinology; (ii) biological activity of DNA. (479)

Department of Biology as Applied to Medicine

Dr. F. S. BILLETT—assistance: effect of nucleic acid antimetabolites on the early development of avian embryos. (480)

Dr. N. E. GILLIES—assistance: restoration of bacterial cells exposed to ionizing or ultraviolet radiation. (481)

Professor D. R. NEWTH—expenses (from special funds for the purchase of costly apparatus): cellular sensitivity to ionizing radiations. (482)

Courtauld Institute of Biochemistry

Professor Sir Charles DODDS—expenses (from special funds for the purchase of costly apparatus): measurement of optical densities. (483)

Dr. A. E. KELLIE—expenses: steroid sex hormones. (484)

Dr. Patricia MCLEAN—assistance: carbohydrate metabolism in the mammary glands. (485)

Dr. I. M. ROITT—assistance and expenses: (i) hypersensitivity in human autoimmune disease; (ii) investigation of autoimmune nature of thyrotoxicosis. (486)

Institute of Clinical Research

Dr. F. R. BETTLEY—assistance and expenses: transepidermal water loss. (487)

Mr. N. THOMPSON—expenses: survival and re-innervation of free autogenous transplants of skeletal muscles in dogs. (Formerly at Stoke Mandeville Hospital, Bucks.) (488)

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Institute of Nuclear Medicine

Dr. J. L. H. O'RIORDAN—expenses: immunoassay of glucagon. (489)

Dr. W. S. REITH—assistance and expenses: iodotyrosines and thyroid hormones in various states of thyroid function. (490)

Professor J. E. ROBERTS—assistance and expenses; thyroid hormones in various states of thyroid function. (491)

Dr. E. S. WILLIAMS—expenses: new scanning techniques in the diagnosis and location of tumours. (492)

Pharmacology Department

Professor C. A. KEELE—assistance: identification of an intracellular substance which causes the sensation of pain. (493)

MOUNT VERNON HOSPITAL

Mr. I. F. K. MUIR—assistance and expenses: blood flow of pedicle and flap grafts used in plastic and reconstructive surgery. (494)

NATIONAL HOSPITAL, QUEEN SQUARE

Institute of Neurology

Dr. E. H. REYNOLDS—personal and expenses: electrolyte distribution in epilepsy. (Also at the Medical Research Council's Neuropsychiatric Research Unit, Carshalton, and at West Park Hospital, Epsom.) (495)

Psychology Department

Dr. E. K. WARRINGTON—assistance: experimental analysis of perceptual disorders. (496)

NATIONAL INSTITUTE FOR MEDICAL RESEARCH

Biochemistry Division

Dr. K. FREEMAN—personal: mitochondria. (497)

Human Physiology Division

Dr. S. BLACK—personal: mechanisms involved in the inhibition, by direct suggestion under hypnosis, of allergic skin reactions. (498)

Physiology and Pharmacology Division

Dr. E. A. CARMICHAEL—personal: pathways of absorption between the blood, cerebrospinal fluid and brain substance. (499)

NATIONAL PHYSICAL LABORATORY

Dr. I. P. PRIBAN—personal, assistance and expenses: control of breathing using control systems theory and an analogue computer. (500)

NEW END HOSPITAL

Dr. E. S. SHALOM—personal and expenses: iodine constituents in the blood and urine. (501)

NUFFIELD INSTITUTE OF COMPARATIVE MEDICINE

Dr. P. A. J. BALL—personal and expenses: immunity to *Necator americanus*. (502)

POSTGRADUATE MEDICAL SCHOOL OF LONDON AND HAMMERSMITH HOSPITAL

Anaesthetics Department

Dr. M. K. SYKES—expenses: respiratory function after heart, lung and abdominal surgery. (503)

Bacteriology Department

The late Professor Mary BARBER—(1) expenses: laboratory and clinical studies of new antibiotics, with special reference to new penicillins; (2) assistance and expenses: antibacterial chemotherapy. (504)

Dr. Naomi DATTA—expenses: transmissable drug resistance among Enterobacteriaceae. (505)

Chemical Pathology Department

Dr. K. FOTHERBY—assistance and expenses: metabolism of ovulation-suppressing agents. (506)

Dr. I. MACINTYRE—assistance and expenses: experimental magnesium deficiency in the rat. (507)

Professor I. D. P. WOOTTON and Dr. J. R. HOBBS—expenses; protein studies during MRC therapeutic trial in myelomatosis. (508)

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Medical Physics Department

Professor J. F. FOWLER—(1) assistance and expenses: effect of fractionated irradiation of normal tissue and tumours in animals; (2) expenses: thermoluminescent dosimetry; (3) expenses (from special funds for the purchase of costly apparatus): improved radioisotope localization techniques for diagnosis and *in vivo* tumour studies. (509)

Department of Medicine

Dr. C. C. BOOTH—assistance: compensatory mechanisms in the small intestine. (510)

Dr. E. J. M. CAMPBELL—(1) assistance: particle deposition in the lungs; (2) expenses: development of a method for the measurement of mixed venous CO_2 tension during exercise. (511)

Dr. C. L. COPE—expenses: aldosterone metabolism in human disease. (512)

Dr. C. M. FLETCHER—assistance and expenses: preclinical stages of chronic bronchitis. (513)

Professor T. RUSSELL FRASER—(1) expenses: clinical trials of human growth hormone (on behalf of the Council's Clinical Endocrinology Committee); (2) assistance and expenses: assay of growth hormone in serum; (3) assistance and expenses: nature of serum 'atypical' insulin-like activity. (514)

Professor Sir John MCMICHAEL—(1) assistance and expenses: pathology of retinitis in hypertension and diabetes; (2) assistance and expenses: lung function in health and disease; (3) assistance and expenses: relationship of gout to hypertension. (515)

Dr. O. M. WRONG—assistance: action of aldosterone on the electrolyte composition of human cells grown in tissue culture. (516)

Morbid Anatomy Department

Dr. B. E. HEARD—assistance and expenses: obliteration of small bronchi and non-respiratory bronchioles. (517)

Pathology Department

Dr. H. K. WEINBREN—(1) assistance: chemical mechanisms in regeneration of the liver; (2) assistance: regeneration of the liver after resection, and related work. (518)

Professor I. D. P. WOOTTON—expenses: radioactive trace studies of the fate of injected and inhaled dust particles in the lung. (Grant previously held by Dr. E. H. Belcher.) (519)

PUBLIC HEALTH LABORATORY SERVICE

PUBLIC HEALTH LABORATORY SERVICE BOARD—expenses: co-ordinated studies of the pattern of infection in acute respiratory virus infections. (520)

Cross-Infection Reference Laboratory

Professor R. E. O. WILLIAMS and Dr. O. M. LIDWELL—assistance and expenses: comfort conditions in operating theatres. (521)

Enteric Reference Laboratory

Dr. E. S. ANDERSON—assistance and expenses: constitution of the cell in *Salmonella paratyphi B* and related organisms. (522)

Epidemiological Research Laboratory

Dr. J. C. MCDONALD—assistance and expenses: evaluation of γ-globulin in prevention of congenital malformations due to rubella and undefined infections in early pregnancy. (523)

Dr. T. M. POLLOCK—assistance and expenses: γ-globulin in the prevention of congenital defects. (524)

QUEEN CHARLOTTE'S HOSPITAL

Dr. Rosalinde HURLEY—assistance: pathogenicity of commensal species of the genus *Candida*, and of the mechanisms of their sensitivity to nystatin and other polyene antibiotics. (525)

QUEEN ELIZABETH COLLEGE

Nutrition Department

Professor J. YUDKIN—(1) assistance and expenses: dietary composition and the efficiency of food utilization; (2) assistance and expenses: dietary and blood chemistry of subjects with non-traumatic arterial disease. (526)

Physiology Department

Dr. B. C. WHALER—assistance and expenses: ionic movements at the nerve endings of normal and botulinum-poisoned nerve-muscle preparations. (527)

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Chemistry Department

Dr. E. W. RANDALL—assistance and expenses: hydrogen bonding, structure and tautomerism in molecules of biological importance. (528)

ROSS INSTITUTE OF TROPICAL HYGIENE

Professor G. MACDONALD—assistance: genetics of anopheline mosquitoes. (529)

ROYAL COLLEGE OF SURGEONS OF ENGLAND

Research Department of Anaesthetics

Professor W. W. MUSHIN—assistance: interaction of pethidine and myoneural blocking agents in anaesthetized patients. (530)

Professor J. P. PAYNE—assistance and expenses: circulatory, respiratory and metabolic responses to high concentrations of carbon dioxide during anaesthesia. (531)

Biochemistry Department

Professor C. LONG—assistance and expenses: brain lipids. (532)

Dental Science Department

Professor B. COHEN—assistance: (i) reaction of bone cells to the presence of secondary carcinomatous deposits; (ii) comparison of the normal processes of keratinization in the mouth epithelium with those observed in cancerous and precancerous lesions. (533)

Pathology Department

Professor G. J. CUNNINGHAM—assistance and expenses: cytochemical studies on early cell damage, particularly in the liver. (534)

Pharmacology Department

Professor G. V. R. BORN—(1) expenses: biochemical changes occurring in blood platelets and plasma during clotting; (2) assistance: blood platelet aggregation. (535)

Physiology Department

Sir Victor NEGUS—expenses: pump action on the circulation. (536)

ROYAL DENTAL HOSPITAL

School of Dental Surgery

Dr. W. G. ARMSTRONG—assistance and expenses: nature of the modifications to the dentine matrix caused by dental caries. (537)

Mr. J. D. MANSON—expenses: bone growth and bone activity in the mandible. (538)

ROYAL EYE HOSPITAL

Professor A. SORSBY—expenses (partly from Alexander Pigott Wernher Memorial Trust Funds): variations in the components of refraction during growth. (539)

ROYAL FREE HOSPITAL

Chemical Pathology Department

Professor D. N. BARON—(1) assistance and expenses: computer studies on the correlation between signs and symptoms and laboratory findings in liver disease (also at the University of London Computer Unit); (2) assistance and expenses: purification, properties and distribution of isoenzymes of NADP-specific isocitrate dehydrogenase. (540)

ROYAL FREE HOSPITAL (NORTH WESTERN BRANCH, HAMPSTEAD)

Surgical Research Department

Dr. F. S. FREISINGER—expenses: an antibody to urease and its possible relation to gastric ulcer. (541)

ROYAL FREE HOSPITAL SCHOOL OF MEDICINE

Anatomy Department

Dr. P. R. DAVIS—assistance and expenses: effects of material-handling methods on respiratory and trunk mechanics. (542)

Biochemistry and Chemistry Department

Dr. H. BAUM—assistance and expenses: biochemistry of induced thermogenesis in the neonate. (543)

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Haematology Department

Dr. C. S. PITCHER—expenses: iron metabolism in haemochromatosis. (544)

Department of Medicine

Dr. Barbara H. BILLING—assistance: bile pigment metabolism in jaundice. (545)

Dr. A. M. DAWSON—expenses: the effect of bile salts on the esterification of fatty acids by the small gut mucosa. (546)

Professor Sheila SHERLOCK—(1) assistance: kinetics of galactose, glucose and fructose absorption; (2) assistance: fat absorption; (3) expenses (from special funds for the purchase of costly apparatus): protein production, iron metabolism and the hepatic circulation in liver disease, and the immunoassay of hormones; (4) assistance and expenses: drug metabolism in liver disease. (547)

Dr. R. S. WILLIAMS—expenses: iron absorption in cirrhosis and haemochromatosis. (548)

Medical Physics Department

Dr. N. F. KEMBER—expenses: effects of radiation on the cellular complement of rat bone. (549)

Professor H. A. B. SIMONS—assistance and expenses: possible protective action against ionizing radiations of a series of compounds incorporating the thioureido and guanidino structures. (550)

Morbid Anatomy Department

Dr. G. B. D. SCOTT—expenses: thrombotic sequelae of the generalized Schwartzman reaction. (551)

Pharmacology Department

Dr. J. R. HODGES—assistance: mechanisms controlling the release of adrenocorticotrophic hormone from the adenohypophysis. (552)

Professor Eleanor J. ZAIMIS—(1) assistance: mode of action of reserpine; (2) assistance and expenses: drug-induced myocardial abnormalities. (553)

Physiology Department

Dr. J. C. G. COLERIDGE—assistance and expenses: reflexogenic receptors in the pulmonary circulation. (554)

Professor C. B. B. DOWNMAN—assistance and expenses: supraspinal control of visceral activity. (555)

Dr. R. E. MOORE—assistance and expenses: control of heat production in the newborn. (556)

ROYAL HOLLOWAY COLLEGE

Zoology Department

Dr. G. I. TWIGG—assistance and expenses: *Leptospira* in rodent populations. (557)

ROYAL MARSDEN HOSPITAL

Clinical Pathology Department

Dr. H. E. M. KAY—assistance and expenses: collection and preservation of foetal tissues. (558)

Clinical Research Department

Dr. C. B. CAMERON—expenses: role of 6-phosphogluconate dehydrogenase and related enzymes in the development of neoplasia, with special reference to the early diagnosis of uterine cancer. (559)

SCHOOL OF PHARMACY

Pharmacology Department

Professor G. A. H. BUTTLE—assistance: relation between embryonic and malignant growth and conditions giving rise to antigenic responses in the host. (560)

ST. BARTHOLOMEW'S HOSPITAL MEDICAL COLLEGE

Biochemistry Department

Professor E. M. CROOK—expenses (from special funds for the purchase of costly apparatus): physico-chemical properties of imidazole. (561)

Dr. G. E. FRANCIS—assistance and expenses: chemistry of natural products of British Guiana of medicinal importance. (562)

Pathology Department

Professor W. G. SPECTOR—(1) expenses: mechanics of increased capillary permeability; (2) expenses: (i) lymphoid cell factors as mediators of local hypersensitivity reactions; (ii) origin and fate of mononuclear cells in inflammatory exudates. (563)

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Pharmacology Department

Professor J. P. QUILLIAM—(1) assistance: spinal neuropharmacology; (2) assistance: relation of electron-microscopic structure of ganglion cells to pharmacological action. (564)

Physics and Physiology Departments

Professor J. ROTBLAT—(1) assistance and expenses: long-term effects of radiation, with particular reference to their relation to age of subject at the time of irradiation; (2) assistance: age factor in radiation sensitivity of mammals. (565)

Physiology Department

Professor M. DE BURGH DALY—(1) expenses: mechanisms underlying the control of the circulation by chemoreceptors; (2) assistance: control of heart rate by chemoreceptors in the lungs. (566)

Dr. B. N. DAVIES—expenses: synthesis and release of noradrenaline at postganglionic nerve endings. (567)

Dr. E. W. HORTON—assistance and expenses: metabolism and physiological significance of the prostaglandins. (568)

Zoology and Comparative Anatomy Department

Dr. D. LACY—assistance and expenses: mammalian spermatogenesis. (569)

ST. GEORGE'S HOSPITAL

Cardiac Department

Dr. A. G. LEATHAM—assistance: coronary artery disease. (570)

Department of Medicine

Dr. J. BATTEN—expenses: (i) development and application of a method of measuring trunk expansion; (ii) tests of bronchial sensitivity and airway resistance. (571)

ST. GEORGE'S HOSPITAL MEDICAL SCHOOL

Bacteriology Department

Dr. H. P. LAMBERT—expenses: Eaton agent in chronic respiratory disease. (572)

Chemical Pathology Department

Professor N. H. MARTIN—(1) assistance and expenses: nature of the interaction of metals with proteins with special reference to the naturally occurring metalloproteins; (2) expenses (from special funds for the purchase of costly apparatus): separation of polypeptide fragments. (573)

Haematology Department

Dr. J. L. STAFFORD—assistance and expenses: comparative study of blood coagulation and fibrinolysis in West African and English males (in association with University College, Ibadan). (574)

Department of Medicine

Professor A. C. DORNHORST—(1) expenses: clinical trial of diet in coronary thrombosis (with Professor J. N. Morris); (2) expenses (from special funds for the purchase of costly apparatus): influence of diet on lipid metabolism. (575)

Pathology Department

Professor T. CRAWFORD—expenses: comparative study of arterial pathology and histochemistry in autopsied patients from London and Glasgow. (576)

Psychiatry Department

Mr. H. Gwynne JONES—assistance and expenses: visual perceptual functioning in patients with localized cerebral lesions. (577)

Surgical Unit

Professor B. N. BROOKE—assistance and expenses: steroid therapy in ulcerative colitis. (578)

ST. MARK'S HOSPITAL

Dr. B. C. MORSON—assistance and expenses: (i) pathogenesis of inflammatory diseases of the large intestine; (ii) mechanism of venous embolism in cancer of the large intestine; (iii) histopathology of anal cancer. (579)

Dr. A. C. YOUNG—assistance and expenses: angiography of the colon in neoplasm, diverticular disease and ulcerative colitis. (580)

Research Department

Mr. A. G. PARKS—assistance and expenses: *in vitro* study of human alimentary smooth muscle. (581)

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Paediatric Unit

Dr. J. A. AMBROSE—assistance and expenses: nature of distress reactions in infancy. (Also at Medical Research Council Laboratories, Hampstead.) (582)

ST. MARY'S HOSPITAL MEDICAL SCHOOL

Anatomy Department

Dr. A. d'A. BELLAIRS—assistance and expenses: wound healing and regeneration in reptile embryos. (583)

Dr. A. S. BREATHNACH—assistance and expenses: electron microscopy of human skin. (584)

Bacteriology Department

Professor R. E. O. WILLIAMS—assistance and expenses: classification of non-haemolytic streptococci. (585)

Biology Department

Dr. Marjorie ALLANSON—personal and expenses: cytological and histochemical study of the mammalian adenohypophysis. (Also at Zoology Department, King's College.) (586)

Chemical Pathology Department

Dr. H. D. BARNES—personal and expenses: porphyrin metabolism. (587)

Dr. V. H. T. JAMES—expenses: androgen secretion in man. (588)

Immunology Department

Dr. S. COHEN—(1) expenses: mechanism of malarial immunity in Gambian adults; (2) assistance and expenses: association of the A and B chains of human γ-globulin. (589)

Professor R. R. PORTER—assistance: chemical structure of γ-globulin. (590)

Medical Unit

Professor W. S. PEART—expenses: definition of the role of the renal enzyme renin in the control of aldosterone secretion, electrolyte balance by the kidney and renal hypertension. (591)

Metabolic Unit

Dr. V. WYNN—assistance: (i) methods and principles in metabolic medicine; (ii) steroid chemistry, with special reference to androgens. (592)

Obstetrics and Gynaecology Department

Professor I. MACGILLIVRAY—expenses: electrolyte studies in pregnant women. (593)

Pathology Department

Dr. K. A. PORTER—expenses: immunological study of X-irradiated animals with marrow transplants. (Also in Bacteriology Department.) (594)

Dr. E. A. WRIGHT—assistance and expenses: oxygen tension in animals' brains during 'nitrogen' hypoxia, with a view to the treatment of brain tumours with radiation. (595)

Pharmacology Department

Dr. P. A. NASMYTH—assistance and expenses: relationship of adenosine 3',5'-phosphate to the activity of sympathomimetic amines. (596)

Physiology Department

Dr. R. CREESE—expenses: sodium exchange in isolated muscle. (597)

Dr. Pamela M. HOLTON—expenses: chemical transmitters at nerve endings. (598)

Professor A. St. G. HUGGETT—expenses: location of fructose in the sheep foetus. (599)

Dr. J. F. MITCHELL—expenses: release of transmitter substances from central synapses. (600)

Surgical Unit

Mr. J. R. KENYON—expenses: deep hypothermia with exsanguination and total circulatory arrest, and its application to human patients for certain surgical procedures. (601)

Wright-Fleming Institute of Microbiology

Dr. R. R. DAVIES—assistance and expenses: promotion of fungal infection by antibiotic and other drug treatment. (602)

Dr. G. W. CSONKA—personal and expenses: aetiology of non-gonococcal genital infections. (Also at Central Middlesex Hospital and Twyford Virus Laboratory.) (603)

Professor R. E. O. WILLIAMS and Dr. Margot SHINER—assistance and expenses: intestinal bacterial flora in healthy humans. (604)

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Anaesthetics Department

Dr. T. H. S. BURNS—personal: development of non-explosive anaesthetic agents (in collaboration with Dr. J. M. Hall, Guy's Hospital). (605)

Dr. H. C. CHURCHILL-DAVIDSON—expenses: neuromuscular transmission in man. (606)

Radiography Department

Dr. I. CHURCHILL-DAVIDSON—assistance: use of high-pressure oxygen in the radiotherapy of malignant tumours. (607)

Dr. G. WIERNIK—personal and expenses: effect of ionizing radiation in tissues. (608)

ST. THOMAS'S HOSPITAL MEDICAL SCHOOL

Biophysics Department

Professor J. R. MALLARD—expenses: continuous averaging techniques in electron-spin resonance. (609)

Chemical Pathology Department

Professor F. T. G. PRUNTY—assistance and expenses: steroid metabolism. (610)

Medical Microbiology Department

Professor A. P. WATERSON—assistance and expenses: viral structure and multiplication using electron microscopy. (611)

Department of Medicine

Dr. S. T. G. SEMPLE—assistance and expenses: chemical control of ventilation in man and respiratory and cardiovascular effects of tracheostomy and artificial ventilation. (612)

Pathology Department

Professor R. C. CURRAN—assistance and expenses: mucopolysaccharides in (i) atherosclerosis, (ii) fibrous repair. (613)

Professor R. C. CURRAN and Dr. A. J. HALE—assistance: development of a scanning X-ray microanalyser for quantitative cytochemistry. (614)

Surgery Department

Professor J. B. KINMONTH—assistance and expenses: (i) endolymphatic therapy of transplantable tumours; (ii) lymphangiography. (615)

UNIVERSITY COLLEGE LONDON

Anatomy and Embryology Departments

Professor J. Z. YOUNG—assistance: synaptic structure in the autonomic nervous system. (616)

Anthropology Department

Professor N. A. BARNICOT—assistance: the human karyotype in various populations. (617)

Biochemistry Department

Professor E. H. F. BALDWIN—(1) expenses (from special funds for the purchase of costly apparatus): interactions of proteins and of their sub-units; (2) assistance and expenses: structural and enzymatic studies on myosin. (618)

Mrs. P. H. CLARKE—(1) assistance; structure and mode of synthesis of cell walls of *Pseudomonas* spp.; (2) assistance and expenses: studies on amidase production by mutant strains of *Pseudomonas aeruginosa.* (619)

Dr. S. P. DATTA—assistance and expenses: kinetic and calorimetric study of the reaction catalysed by the enzyme isocitrate lyase. (620)

Mr. G. A. ELLARD—personal and expenses: potentially antileprotic diphenylthioureas in laboratory animals and in man and their effects on the metabolism of certain non-pathogenic mycobacteria and on *Mycobacterium leprae.* (621)

Dr. A. L. GREENBAUM—(1) assistance and expenses: control of metabolism by the pyridine nucleotides; (2) expenses: hormonal control of metabolism; (3) expenses: a computer program for studies on carbohydrate and fat metabolism. (622)

Dr. L. M. KERLY—assistance and expenses: amino acid metabolism in the perfused rat liver. (623)

Dr. K. L. MANCHESTER—assistance and expenses: hormones and protein synthesis in muscle. (624)

Dr. A. P. MATHIAS—expenses: isolation of the messenger RNA responsible for the synthesis of amidohydrolase in *Pseudomonas aeruginosa.* (625)

Dr. D. B. RODDYN—expenses: protein synthesis in mitochondria. (626)

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Biophysics Department

Dr. P. FATT—assistance: mechanism of visual excitation. (627)

Botany and Chemistry Departments

Dr. D. WILKIE and Dr. D. V. BANTHORPE—assistance and expenses: genetics and chemistry of actidione action in yeast. (628)

Chemistry Department

Dr. C. A. VERNON—assistance: enzymic transamination. (629)

Dr. A. WASSERMANN—assistance and expenses: molecular size and shape of muscle proteins in dilute solution. (630)

Crystallography Department

Professor Dame Kathleen LONSDALE—assistance and expenses: X-ray studies of endemic bladder stones. (631)

Eugenics, Biometry and Genetics Department

Professor L. S. PENROSE—assistance: chromosomal translocations. (632)

The Galton Laboratory

Professor C. A. B. SMITH—assistance: statistical study of factors associated with spontaneous abortion. (633)

Pharmacology Department

Professor H. O. SCHILD and Dr. C. A. VERNON—assistance and expenses: identification of urogastrone. (634)

Physiology Department

Dr. H. DAVSON—assistance: mechanism of formation and drainage of the cerebrospinal fluid. (635)

Professor J. A. B. GRAY—assistance and expenses: transmission of information about external stimuli in primary and second-order receptor neurones. (636)

Dr. R. D. HARKNESS—expenses: estimation of hydroxyproline. (637)

Dr. O. C. J. LIPPOLD—(1) expenses: long-term effects of polarizing currents on the rat cerebral cortex; (2) assistance and expenses: the mechanism by which polarizing currents produce long-lasting changes in the spontaneous firing of cortical cells. (638)

Mr. J. E. PASCOE—(1) expenses: central control of muscle spindles; (2) assistance and expenses: relative importance of α- and γ-activation in muscle reflexes. (639)

Dr. M. SCHACHTER—assistance: possible physiological significance of kinins and of the enzymes which release them. (640)

Dr. D. R. WILKIE—expenses: muscle physiology. (Also at Plymouth Marine Biological Laboratory.) (641)

Psychology Department

Professor G. C. DREW—assistance and expenses: inductive and deductive thinking. (642)

Miss G. H. KEIR—assistance and expenses: psychological study of the children of school age in the Tristan da Cunha settlement. (Also at Fawley Schools, Southampton.) (643)

Student Health Service Department

Dr. C. J. LUCAS—assistance and expenses: prevalence of mental ill-health in a population of university students. (644)

Zoology Department

Mr. J. M. SMITH—assistance: protein synthesis and aging in *Drosophila*. (645)

Dr. K. VICKERMAN—expenses: changes in the life cycle of trypanosomes. (646)

UNIVERSITY COLLEGE HOSPITAL

Clinical Pathology Department

Dr. F. V. FLYNN—assistance and expenses: proteinuria accompanying generalized renal tubular malfunction. (647)

Obstetrics Department

Dr. Mavis GUNTHER—personal and expenses: development of immune responses to cows' milk in infants during the first weeks of life. (648)

Respiratory Function Laboratory

Dr. P. J. D. HEAF—assistance: (i) effects of respiratory stimulants on the ventilation; (ii) cinebronchography; (iii) circulatory failure in cases of intermittent positive pressure ventilation. (649)

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Bacteriology Department

Professor G. BELYAVIN—(1) assistance: antibody response to poliovirus immunization; (2) expenses: haemagglutination inhibition produced by influenza virus. (650)

Chemical Pathology Department

Dr. H. HEATH—assistance and expenses: metabolism of the retina and other ocular tissues in alloxan-produced diabetes. (651)

Dr. T. F. SLATER—assistance and expenses: energy mechanisms in biliary secretion. (652)

Graham Research Laboratories

Professor Sir Roy CAMERON and Professor G. BELYAVIN—expenses (from special funds for the purchase of costly apparatus): electron microscope for use in the Department of Morbid Anatomy for studies on the mechanism of cell injury and in the Department of Bacteriology for virus particle counting and studies on virus structure. (653)

Medical Unit

Professor C. E. DENT—(1) assistance: osteoporosis in young people; (2) assistance and expenses: (i) alkaline phosphatase in bone disease; (ii) blood calcium and blood phosphate levels. (654)

Dr. C. J. DICKINSON—expenses: (i) renal pulse pressure in relation to the rate of urine excretion; (ii) cerebral vascular resistance in the control of blood pressure. (655)

Professor M. L. ROSENHEIM—expenses (from special funds for the purchase of costly apparatus): analysis of blood constituents. (656)

Mr. R. G. WESTALL—expenses: inherited diseases which exhibit disorders of amino acid metabolism. (657)

Morbid Anatomy Department

Sir Roy CAMERON—assistance and expenses: investigation into liver disturbances due to schistosomal infection. (658)

Dr. J. F. SMITH—expenses: rate of reabsorption of protein from the cerebrospinal fluid. (659)

Obstetric Unit

Professor W. C. W. NIXON—assistance and expenses: aetiology and diagnosis of carcinoma of the cervix. (660)

Dr. C. N. SMYTH—expenses: relation of posture to the duration, discomfort and forces of labour in human subjects. (661)

Paediatrics Department

Dr. L. B. STRANG—assistance and expenses: pathogenesis of hyaline membrane disease. (662)

UNIVERSITY OF LONDON COMPUTER UNIT

Professor R. A. BUCKINGHAM and Dr. A. ELITHORN—assistance and expenses: factors which determine failures in problem solving by human subjects. (663)

WESTFIELD COLLEGE

Chemistry Department

Professor W. KLYNE—assistance and expenses: preparation of compounds for the Steroid Reference Collection. (664)

Zoology Department

Dr. J. A. RIEGEL—expenses: functional mechanism of the cray-fish antennal gland. (665)

WEST MIDDLESEX HOSPITAL

Dr. N. F. COGHILL—assistance: aspirin-induced exfoliation of gastric epithelial cells. (666)

Dr. P. M. MCALLEN—assistance and expenses: clinical trial of diet in coronary thrombosis (with Professor J. N. Morris). (667)

WESTMINSTER HOSPITAL

Mr. P. D. TREVOR-ROPER—assistance: long-term preservation of human cornea. (668)

Dr. J. H. WILKINSON—assistance and expenses: specificity of serum enzyme tests. (669)

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WESTMINSTER MEDICAL SCHOOL

Mr. B. ALTMAN—expenses: serological test for transplantation antibody. (Also at Royal Veterinary College and Queen Victorial Hospital, East Grinstead.) (670)

Chemical Pathology Department

Professor N. F. MACLAGAN—(1) assistance and expenses: origin and absorption of blood phospholipids; (2) assistance and expenses: familial hypercholesterolaemic xanthomatosis. (671)

Surgery Department

Mr. A. G. HORSBURGH—expenses: transference of mucosa in the gastrointestinal tract, with reference to the treatment of ulcerative colitis. (672)

Surgical Unit

Dr. A. D. M. SMITH—personal: cyanide metabolism in man. (673)

WHITTINGTON HOSPITAL

Dr. A. M. JOEKES—assistance and expenses: abnormalities of renal function in man. (Also at St. Philip's Hospital.) (674)

Paediatric Department

Dr. S. YUDKIN—assistance and expenses: serum proteins in children. (675)

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Dr. R. H. CAWLEY—assistance and expenses: clinical trial of antidepressant drugs, for the Clinical Psychiatry Committee. (676)

Dr. Joan FAULKNER—expenses: investigation into convulsive disorders (for the Committee for Research in General Practice). (677)

Lady M. MELLANBY—expenses: the structure of teeth. (678)

Dr. A. RYLE—(1) personal and expenses: neuroticism and family relationships of 14-year-old children; (2) personal and expenses: development of a marital patterns test. (679)

Manchester

COLLEGE OF SCIENCE AND TECHNOLOGY

Chemical Engineering, Fuel Technology and Metallurgy Department

Professor F. MORTON—expenses: isolation of aromatic hydrocarbons from petroleum. (680)

ROYAL INFIRMARY

Department of Medicine

Dr. Pamela E. AYLETT—personal and expenses: (i) gastric physiology and peptic ulcer; (ii) serotonin and histamine in ulcerative colitis. (681)

University Department of Surgery

Mr. D. L. L. GRIFFITHS—assistance and expenses: tuberculosis of the spine in the tropics. (682)

UNIVERSITY

Chemistry Department

Dr. G. R. BARKER—assistance: nucleotide analogues and bacterial growth. (683)

Dr. F. R. JEVONS—(1) assistance and expenses: mode of action of enzymes acting on the carbohydrate moieties of mucoproteins; (2) assistance and expenses: naturally occurring glycopeptides. (684)

Dr. W. D. STEIN—(1) assistance: isolation of the glucose transport system from the membrane of the human red blood cell; (2) expenses: direct visual localization of a transport system in the membrane of the human red blood cell. (685)

Dr. C. H. WYNN—assistance and expenses: specificity of the collagenolytic activity of rat liver lysosomes. (686)

Clinical Sciences Department

Mr. W. B. JENNETT—expenses: experimental cerebral compression. (687)

Department of Education of the Deaf

Sir Alexander EWING—assistance and expenses (partly from the Alexander Piggott Wernher Memorial Trust Funds): the problems of parents of deaf children. (688)

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Nuffield Department of Occupational Health

Dr. G. R. C. ATHERLEY—expenses: recovery from temporary threshold shift arising from industrial noise exposure. (689)

Dr. W. R. LEE—expenses: experimental study of effect of electric shock on respiration. (690)

Pathology Department

Dr. A. H. GOWENLOCK—assistance: determination of vitamin D in serum. (691)

Preventive Dentistry Department

Professor J. L. HARDWICK—assistance and expenses: fluoride content of the dental plaque. (692)

Psychiatry Department

Professor E. W. ANDERSON—assistance and expenses: psychiatric disorder in an English town. (693)

Social and Preventive Medicine Department

Dr. Zena A. STEIN—personal and expenses: (i) mental illness in Salford, with analyses by electronic computer; (ii) school health studies in Leigh (also at the Computing Laboratory and the Salford City Mental Health Department). (694)

Dr. M. W. SUSSER—assistance and expenses: programming medical and survey data for analysis by the Atlas computer. (695)

Menston, Ilkley

HIGH ROYDS HOSPITAL

Dr. R. P. HULLIN and Dr. R. MCDONALD—assistance and expenses: changes in body water and electrolytes in manic-depressive psychosis and depressive illness. (696)

Mickley-on-Tyne

Professor G. R. CLEMO—expenses: chemical constituents of cigarette smoke. (697)

Newcastle upon Tyne

GENERAL HOSPITAL

Regional Neurological Centre

Mr. L. P. LASSMAN and Mr. C. C. M. JAMES—expenses: spina bifida occulta and associated lesions of the spinal cord. (698)

PRINCESS MARY MATERNITY HOSPITAL

Midwifery and Gynaecology Department

Professor J. K. RUSSELL—assistance and expenses: Newcastle upon Tyne Maternity Survey. (699)

ROYAL VICTORIA INFIRMARY

Clinical Biochemistry Department

Professor A. L. LATNER—assistance and expenses: studies of isoenzymes by starch gel electrophoresis. (700)

Dermatology Department

Professor S. SHUSTER—expenses: effect of various diseases on skin connective tissues. (701)

Midwifery and Gynaecology Department

Dr. D. V. I. FAIRWEATHER—expenses: effect of age and parity on the urinary excretion of sex hormones in normal pregnancy. (702)

University Department of Psychological Medicine

Professor M. ROTH—assistance and expenses: psychometric assessment of cerebral damage. (703)

RUTHERFORD COLLEGE OF TECHNOLOGY

Physics Department

Dr. M. A. SLIFKIN—expenses: charge-transfer forces in organic and biochemical systems. (704)

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UNIVERSITY

Anatomy Department

Dr. R. S. SNELL—expenses: melanin pigmentation in the skin. (705)

Dr. C. H. TONGE—expenses: histological studies of the developing tooth and its supporting structures, including the examination of the teeth and jaws in undernourished pigs. (706)

Biochemistry Department

Dr. A. H. EMSLIE-SMITH—assistance and expenses: strain recognition of coliform bacilli in recurrent urinary tract infection. (707)

Chemistry Department

Professor J. WEISS—(1) assistance and expenses: mechanism of the chemical action of ionizing radiations on nucleic acids, nucleoproteins and related compounds; (2) assistance and expenses (from special funds for the purchase of costly apparatus): radiation-induced structural changes in nucleic acids. (708)

Nuffield Department of Industrial Health

Mr. D. N. WALDER—assistance and expenses: decompression sickness. (709)

Pathology Department

Professor A. G. HEPPLESTON—expenses (partly from private funds at the Council's disposal): mechanism of particle disposal in the lung. (710)

Pharmacology Department

Professor J. W. THOMPSON—assistance: (i) enzyme and subcellular aspects of adrenergic transmission; (ii) drug metabolism. (711)

Physiology Department

Professor A. A. HARPER—assistance and expenses: hormonal and nervous effects on gastric and pancreatic secretion. (712)

Mr. G. N. JENKINS—assistance and expenses: the proteins and mucopolysaccharides of the dental plaque. (713)

Dr. B. SCHOFIELD—assistance and expenses: intramural nerve plexuses in the control of gastric secretion. (714)

Dr. H. S. A. SHERRATT—expenses: (i) hypoglycaemic compounds; (ii) energy metabolism of the pancreas. (715)

Dr. W. TAYLOR—assistance and expenses: *in vitro* and *in vivo* metabolism of progesterone. (716)

Surgery Department

Mr. J. E. S. SCOTT—expenses: the dynamic and histological effects on the ureter of the dog of prolonged vesico-ureteric reflux. (717)

Mr. D. N. WALDER—(1) expenses: decompression sickness, with special reference to bone damage and pulmonary pathology, in Blackwall Tunnel workers; (2) expenses: decompression sickness in Tyne Tunnel workers; (3) expenses: decompression sickness in Clyde Tunnel workers. (On behalf of the Decompression Sickness Panel.) (718)

Northampton

PUBLIC HEALTH LABORATORY

Dr. L. HOYLE—expenses: physical and chemical structure of the influenza virus. (719)

Nottingham

MAPPERLEY HOSPITAL

Dr. D. MACMILLAN—assistance and expenses: subsequent history of schizophrenic patients admitted in 1956 to the Mapperley, Netherne and Severalls Hospitals. (720)

UNIVERSITY

Pharmaceutical Chemistry Department

Professor M. W. PARTRIDGE—expenses (from special funds for the purchase of costly apparatus): polyazapolycyclic carcinogens. (721)

Pharmacology Laboratories

Dr. J. CROSSLAND—expenses: nature and behaviour of chemical transmitter substances in the central nervous system. (722)

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Pharmacy Department

Dr. W. C. EVANS—assistance and expenses: formation of the ditigloyl esters of tropine in the roots of various species of *Datura.* (723)

Psychology Department

Professor C. I. HOWARTH—expenses: temporal characteristics of the visual system. (724)

Zoology Department

Dr. Rosalind S. M. KENT—personal and expenses: reticulo-endothelial system of vertebrates. (725)

Oswestry

THE ROBERT JONES AND AGNES HUNT ORTHOPAEDIC HOSPITAL

Mr. N. W. NISBET—assistance and expenses: experimental problems of transplantation. (726)

Oxford

CHURCHILL HOSPITAL

Radiotherapy Department

Dr. F. ELLIS—assistance and expenses: modification of radiation effects by physical and pharmacological means. (727)

Mr. R. OLIVER—expenses: effect of irradiation by internally deposited radioisotopes on the reproductive integrity of cells. (728)

NUFFIELD INSTITUTE FOR MEDICAL RESEARCH

Professor K. W. CROSS and Dr. G. S. DAWES—expenses: effect of hyperbaric oxygen on the asphyxiated newborn. (729)

Dr. G. S. DAWES—expenses (from special funds for the purchase of costly apparatus): control of the circulation in the foetal lamb. (730)

RADCLIFFE INFIRMARY

Accident Service

Mr. J. C. SCOTT—assistance and expenses: reactions of the blood to injury. (731)

Neurology Department

Dr. E. W. POOLE—expenses: time relationship between EEG phenomena, internal bodily events and external stimuli. (732)

Dr. W. RITCHIE RUSSELL—expenses: war wounds of the brain. (733)

Dr. C. W. M. WHITTY—assistance: referred pain. (734)

Nuffield Department of Clinical Biochemistry

Dr. M. P. ESNOUF—assistance: interactions of the plasma proteins concerned in blood coagulation. (735)

Mr. W. M. KEYNES—expenses (from special funds for the purchase of costly apparatus): calcium and magnesium metabolism. (736)

Mr. J. R. P. O'BRIEN—expenses (from special funds for the purchase of costly apparatus): biological macromolecules. (737)

Dr. A. R. PEACOCKE—(1) assistance and expenses: complexes of non-basic proteins and histones with DNA; (2) assistance: effects of ionizing radiations and other mutagenic agents on the structure of soluble nucleoprotein; (3) expenses (from special funds for the purchase of costly apparatus): molecular weights and shapes of biological macromolecules. (738)

Nuffield Department of Clinical Medicine

Dr. E. D. ACHESON—(1) expenses: epidemiological study of ulcerative colitis; (2) expenses: multiple sclerosis in immigrants. (739)

Dr. Sheila T. E. CALLENDER—(1) expenses: family study of pernicious anaemia and ' latent ' pernicious anaemia; (2) expenses (from special funds for the purchase of costly apparatus): absorption of iron and vitamin B_{12}. (740)

Dr. S. C. TRUELOVE—(1) assistance: aetiology of ulcerative colitis, with special reference to immunological aspects; (2) assistance: motor activity of the bowel, with special reference to diverticulosis coli; (3) expenses: aetiology and treatment of ulcerative colitis. (741)

Dr. S. C. TRUELOVE and Dr. G. M. ARDRAN—assistance and expenses: human colonic motility in health and disease. (742)

Professor L. J. WITTS—assistance: pathological effects of iron deficiency in the rat. (743)

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Nuffield Department of Surgery

Mr. A. J. GUNNING—expenses: the use of homologous aortic valve transplants in the surgical treatment of aortic incompetence. (744)

Mr. J. S. S. STEWART—personal and expenses: frozen blood. (745)

Pathology Department

Dr. M. S. DUNNILL—expenses: quantitation in morbid anatomy. (746)

UNIVERSITY

Anatomy and Biochemistry Departments

Dr. V. W. STEWARD—personal, assistance and expenses: assay of 3β-hydroxysteroid dehydrogenase in the testis of the rat. (747)

Biochemistry Department

Dr. K. DALZIEL—assistance and expenses: enzyme kinetics. (748)

Dr. C. A. PASTERNAK—assistance and expenses: control of sulphur and amino sugar metabolism in the mast-cell tumour P815. (749)

Dr. L. A. STOCKEN—(1) assistance: metabolic routes by which DNA precursors are formed; (2) assistance: biochemical effects of ionizing radiation on mammalian systems. (750)

The late Professor D. D. WOODS—expenses: cellular functions of vitamin B_{12} and folic acid in micro-organisms. (751)

Chemical Crystallography Laboratory

Professor Dorothy C. HODGKIN—assistance and expenses: detailed structure determination of vitamin B_{12}. (752)

Dyson Perrins Laboratory

Dr. G. LOWE—(1) assistance and expenses: studies related to the antibiotic cephalosporin C; (2) assistance: structure and mechanism of action of the proteolytic enzyme papain. (753)

Dr. G. T. YOUNG—assistance and expenses: synthesis of arginine vasopressin. (754)

Human Anatomy Department

Dr. S. BRADBURY—expenses: localization of mucopolysaccharides by electron histochemistry. (755)

Dr. D. A. T. DICK—expenses: ion fluxes in single cells. (756)

Mr. T. P. S. POWELL and Dr. W. M. COWAN—expenses: connections of the nuclei of the thalamus and corpus striatum. (757)

Dr. A. G. M. WEDDELL—assistance: structural changes in skin and sensory nerve trunks associated with leprosy and psoriasis. (758)

Inorganic Chemistry Department

Dr. R. J. P. WILLIAMS—(1) expenses (from special funds for the purchase of costly apparatus): metal ions in biological systems; (2) assistance and expenses: metalloprotein complexes, especially in relation to enzymes. (759)

Institute of Experimental Psychology

Dr. E. R. F. W. CROSSMAN—expenses: analysis of human motor control mechanisms. (760)

Dr. M. TREISMAN—assistance and expenses: investigation of the hierarchical mechanisms in auditory and visual perception. (761)

Dr. D. M. VOWLES—assistance: role of the forebrain structures in learning and motivation in the pigeon. (762)

Nuffield Department of Clinical Biochemistry

Professor Sir George PICKERING—expenses (from special funds for the purchase of costly apparatus): quantitative estimations of amino acids in biological fluids and proteins. (763)

Nuffield Department of Surgery

Professor P. R. ALLISON—expenses: venous thrombosis and the natural history of pulmonary emboli. (764)

Nuffield Laboratory of Ophthalmology

Dr. S. G. WALEY—assistance: (i) proteins of the lens; (ii) structure and function in related glycolytic enzymes. (765)

Department of Regius Professor of Medicine

Professor Sir George PICKERING—assistance and expenses: arterial occlusion. (766)

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Pharmacology Department

Dr. H. BLASCHKO—expenses: biochemical pharmacology of catechol amines and of neurophysin. (767)

Dr. Edith BULBRING—assistance: electrophysiology of mammalian vascular smooth muscle. (768)

Professor W. D. M. PATON—(1) assistance: mode of action and individual character of anaesthetics; (2) assistance: drug receptors and uptake of drugs by tissues; (3) assistance and expenses: studies on the renin/angiotensin system; (4) expenses (from special funds for the purchase of costly apparatus): interaction of drugs and receptors. (769)

Physiology Department

Sir Howard FLOREY—(1) expenses: investigation of the structure of blood vessels, with particular reference to the endothelium; (2) expenses: investigation of the ultrastructure of tissues. (770)

Dr. P. B. C. MATTHEWS—assistance: responses of muscle-spindle receptors to controlled mechanical stimuli. (771)

Dr. R. W. TORRANCE—expenses: mechanism of excitation of chemoreceptors. (772)

Professor Sir George PICKERING and Professor Sir Lindor BROWN—assistance and expenses: cardiovascular afferent fibres in animals and in man. (Also at the Radcliffe Infirmary.) (773)

Sir William Dunn School of Pathology

Dr. E. P. ABRAHAM—assistance and expenses: isolation, structure and mode of action of a peptide-like substance produced by *B. subtilis.* (774)

Dr. J. E. FRENCH—expenses: physiology and pathology of blood vessels. (775)

Dr. A. G. SANDERS—expenses: behaviour of platelets and other cells in living vessels. (776)

Dr. W. E. VAN HEYNINGEN—assistance: isolation of a toxin of *Clostridium septicum* and *C. sordellii* and determination of its mode of action. (777)

Dr. J. F. WATKINS—expenses: virus infection and changes at mammalian cell surfaces. (778)

Social Medicine Department

Dr. Alice STEWART—(1) assistance: survey of leukaemia in adults and children; (2) assistance and expenses: malignant diseases in childhood; (3) assistance and expenses: Oxford Cancer Surveys (children and adults). (779)

Zoology Department

Dr. J. B. GURDON—expenses: changes in the function of living cell nuclei on exposure to different cytoplasmic environments. (780)

Professor J. W. S. PRINGLE—assistance and expenses: physiology of mouse trophoblast and effect of extra-uterine pregnancy on the oestrus cycle. (781)

Peaslake

Dr. G. I. WATSON—personal and expenses: infectious diseases in a rural community. (782)

Port of Spain, Trinidad

Dr. B. FISTEIN—expenses (from private funds at the Council's disposal): Chagas' disease. (783)

Reading

UNIVERSITY

Physics Department

Professor R. W. DITCHBURN—assistance and expenses: eye movements in relation to visual perception. (784)

Redcar

Dr. G. K. H. HODGKIN—expenses: records of age, diagnosis and morbidity in a general practice. (785)

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St. Andrews

UNIVERSITY

The Gatty Marine Laboratory

Dr. G. A. HORRIDGE—(1) assistance and expenses: effects of neuropharmacologically active substances on selected ganglia of certain invertebrates; (2) expenses: biophysics of nerve-cell membranes. (786)

Dr. A. J. MATTY—(1) expenses: role of thyroid and pituitary hormones in the tissue metabolism of lower vertebrates; (2) assistance and expenses: effect of hormones on the permeability and transport activity of isolated membranes. (787)

Physiology and Biochemistry Department

Dr. G. R. TRISTRAM—expenses: structure and selective degradation of collagen and the analysis of leaf protein. (788)

Dr. G. R. TRISTRAM and Dr. G. A. J. GOODLAD—expenses (from special funds for the purchase of costly apparatus): (i) separation of normal and tumour cells; (ii) separation of the protein components of tissue, particularly collagen; (iii) fractionation of enzymes. (789)

Sheffield

NETHER EDGE HOSPITAL

Dr. H. F. WEST—assistance and expenses: excretion of corticosteroid hormones in urine and saliva. (790)

ROYAL HOSPITAL

Department of Medicine

Dr. J. R. COX—personal and expenses: control of aldosterone secretion. (791)

ROYAL INFIRMARY

University Department of Surgery

Professor H. L. DUTHIE—expenses: electromyography, sensory and pressure studies in the ano-rectum and their relationship to anal incontinence. (792)

UNITED HOSPITALS

Regional Medical Physics Department

Professor C. H. STUART-HARRIS—expenses (from special funds for the purchase of costly apparatus): excretion of corticosteroid hormones in urine and saliva. (793)

UNIVERSITY

Biochemistry Department

Mrs. P. M. HARRISON—personal and expenses: structure and function of ferritin. (794)

Dr. M. A. G. KAYE—assistance: the biochemical lesion in phenylketonuria. (795)

Dr. J. R. QUALE—assistance: mammalian glyoxylate metabolism. (796)

Child Health Department

Dr. K. S. HOLT—assistance and expenses: assessment of treatment in cerebral palsy. (797)

Dental Pathology Department

Professor J. J. HODSON—expenses (from special funds for the purchase of costly apparatus): pathology of dental caries and mineralization of the dental tissues. (798)

Genetics Department

Dr. B. BURNET—assistance and expenses: physiological genetics of melanotic tumours in *Drosophila melanogaster*. (799)

Human Biology and Anatomy Department

Professor R. BARER—assistance: development and application of histochemical methods in electron microscope studies. (800)

Dr. P. F. HARRIS—expenses: isolation and study of cell fractions from bone marrow following irradiation. (801)

Department of Medicine

Professor C. H. STUART-HARRIS—assistance and expenses: relationship between blood gas tensions and the pulmonary blood pressure. (802)

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Department of Obstetrics and Gynaecology (Jessop Hospital for Women)

Professor C. SCOTT RUSSELL—expenses: computer analysis of obstetric and paediatric data. (803)

Pharmacology and Therapeutics Department

Dr. R. KILPATRICK—expenses (from special funds for the purchase of costly apparatus): oestrogenic hormone production by rabbit ovary. (804)

Dr. D. S. MUNRO—expenses: characterization of the long-acting thyroid stimulator and purification of human pituitary thyroid-stimulating hormone. (805)

Professor G. M. WILSON and Professor J. KNOWELDEN—expenses: pathogenesis of non-toxic goitre. (806)

Professor G. M. WILSON—assistance: nature and concentration of plasma adrenocorticotrophic hormone in Cushing's syndrome and other adrenocortical disorders. (807)

Physiology Department

Dr. V. R. PICKLES—expenses: (i) endometrial prostaglandins in simian and human reproduction; (ii) the mechanism of action of intrauterine contraceptive devices. (808)

Professor D. H. SMYTH—(1) assistance: intestinal absorption; (2) expenses (partly from special funds for the purchase of costly apparatus): functional topography of the intestinal epithelial cell. (809)

Preventive Medicine and Public Health Department

Professor J. KNOWELDEN—assistance and expenses: iodine consumption in goitrous and non-goitrous patients. (810)

Psychology Department

Dr. N. P. MORAY—assistance and expenses: mechanisms of learning and inheritance of behaviour. (811)

Surgery Department

Mr. H. L. DUTHIE—expenses: gastric hypothermia. (812)

Professor A. W. KAY—assistance and expenses: duodenal ulceration, gastric blood flow and alimentary bleeding. (813)

Shenley

Harperbury Hospital

Dr. A. SHAPIRO and Dr. R. A. HINDE—expenses: repetitive movements in low-grade mentally subnormal patients. (814)

Smethwick

SMETHWICK HOSPITAL

Midland Centre for Neurosurgery

Dr. A. L. WOOLF—personal, assistance and expenses: innervation and metabolism of muscle. (815)

Southampton

UNIVERSITY

Dr. E. M. DARMADY—expenses: study of the kidney by electron microscopy. (Also at Portsmouth and Isle of Wight Area Pathological Service Central Laboratory.) (816)

Sydney, Australia

UNIVERSITY

Department of Medicine

Dr. K. T. FOWLER—expenses: visits to various departments in the United Kingdom to advise on the use of mass spectrometers. (817)

Watford

BUILDING RESEARCH STATION

Mr. E. NE'EMAN—personal: problems concerned with fluorescent lighting in hospitals. (818)

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Wickford

RUNWELL HOSPITAL

Neuropathological Laboratory

Dr. J. A. N. CORSELLIS—expenses: (i) neuropathological, clinical and EEG findings in epilepsy; (ii) relation of vascular disease, cerebral degeneration and mental disorder in old age. (819)

Psychology Department

Dr. G. A. FOULDS—assistance and expenses: classification of mental patients. (820)

Dr. A. A. ROBIN—assistance: affective disorders in schizophrenia. (821)

Wigan

ROYAL ALBERT EDWARD INFIRMARY

Pathological Department

Dr. J. SCHRAGER—assistance and expenses: carbohydrate and amino acid components of the gastric mucopolysaccharides. (822)

WRIGHTINGTON HOSPITAL, APPLEY BRIDGE

Orthopaedic Department and Centre for Hip Surgery

Mr. J. CHARNLEY—expenses: postoperative sepsis. (823)

In addition to the support provided under their scheme of short-term research grants, the Council also provide, in particular circumstances, the cost of individual salaries on a reimbursement basis for specific projects being undertaken in universities. Such special grants, which may also include provision for research expenses, are normally on a longer-term basis than is available under the main scheme of research grants. All projects supported in this way are listed below.

Aberdeen

UNIVERSITY

Mental Health Department

Professor W. M. MILLAR—assistance and expenses: relationship between the mental health services and psychiatric morbidity in North East Scotland. (824)

Aylesbury

STOKE MANDEVILLE HOSPITAL

Regional Rheumatism Research Centre

Dr. J. N. MCCORMICK—personal and expenses: connective tissue disorders. (825)

Birmingham

BIRMINGHAM AND MIDLAND HOSPITAL FOR WOMEN

Endocrinology Department

Dr. A. C. CROOKE—assistance: gynaecological endocrinology. (826)

Cambridge

UNIVERSITY

Biochemistry Department

Dr. Anne STOCKELL HARTREE—personal, assistance and expenses: purification of hormones from human pituitary glands. (827)

Psychological Laboratory

Mr. A. W. STILL—personal: factors controlling complex learning in the rat. (828)

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UNIVERSITY

Clinical Surgery Department

Professor Sir John BRUCE—(1) assistance and expenses: telemetering biological information in medical and surgical research; (2) assistance and expenses: gastric hypothermia. (829)

Glasgow

UNIVERSITY

Bacteriology Department

Professor R. G. WHITE—assistance: influence of mycobacterial peptidoglycolipids on the biosynthesis of antibody in the guinea pig. (830)

WESTERN INFIRMARY

University Department of Surgery

Professor Sir Charles ILLINGWORTH—expenses; therapeutic use of hyperbaric oxygen.(831)

WESTERN REGIONAL HOSPITAL BOARD

Regional Physics Department

Professor J. H. HUTCHISON and Dr. J. M. A. LENIHAN—assistance and expenses: strontium content of human tissue. (832)

London

INSTITUTE OF CHILD HEALTH

Dr. J. M. TANNER—assistance and expenses: growth and development of children (Harpenden Growth Survey). (833)

INSTITUTE OF PSYCHIATRY

Experimental Neurology Department

Dr. G. ETTLINGER—personal: effects of damage to the cerebral cortex on the ability to make sensory discrimination. (834)

Neuropathology Department

Dr. Sabina STRICH—expenses: congenital malformations of the nervous system. (835)

MIDDLESEX HOSPITAL MEDICAL SCHOOL

Courtauld Institute of Biochemistry

Dr. I. M. ROITT—assistance and expenses: connective tissue diseases. (836)

Pharmacology Department

Dr. V. EISEN—personal: studies on bradykinin and related peptides. (837)

ST. GEORGE'S HOSPITAL MEDICAL SCHOOL

Psychiatry Department

Mr. H. GWYNNE JONES—personal: (i) psychological effects of localized brain lesion; (ii) effects of stress on performance; (iii) aspects of ' behaviour therapy'. (838)

ST. MARY'S HOSPITAL MEDICAL SCHOOL

Surgical Unit

Professor W. J. IRVINE—assistance and expenses: the homograft response and tumour immunity. (839)

UNIVERSITY COLLEGE

Anatomy Department

Dr. P. GRAZIADEI—personal: fine structure of the nervous system. (840)

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Zoology Department

Dr. A. COMFORT—personal, assistance and expenses: biology of ageing. (841)

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL

Dermatology Department

Dr. R. I. C. SPEARMAN—personal and expenses: epidermal growth and keratinization. (842)

Medical Unit

Dr. D. C. CUSWORTH—personal: metabolic disorders in man, particularly those involving amino acids. (843)

Stoke-on-Trent

CITY GENERAL HOSPITAL

Respiratory Physiology Department

Dr. M. C. S. KENNEDY—expenses: natural history of the asthma–bronchitis–emphysema syndrome. (844)

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Fellowships and Scholarships

ROCKEFELLER TRAVELLING FELLOWSHIPS IN MEDICINE

The Rockefeller Travelling Fellowships in medicine awarded by the Council for the academic year 1963–64 were the last in the series generously provided by the Foundation. As reported in the Council's last annual report, they are being replaced by the Council's own travelling fellowships.

The following appointments to Rockefeller Fellowships were made by the Council for the academic year 1963–64:

DR. M. E. ABRAMS (*Department of Experimental Medicine, Guy's Hospital Medical School, London*): techniques of left heart catheterization—at the Cardiovascular Research Institute, San Francisco, California (under Dr. J. H. Comroe).

MR. I. CAMPBELL CREE (*Professorial Surgical Unit, Charing Cross Hospital, London*): homografting of bone marrow, foetal haemopoietic tissue, skin and kidneys in dogs after administration of cytotoxic drugs—at the Mayo Clinic, Rochester, Minnesota (under Dr. G. Hallenbeck).

DR. W. R. CATTELL (*Professorial Medical Unit, St. Bartholomew's Hospital, London*): metabolic and renal studies on acid–base control in human subjects in health and disease—at Boston University and the Massachusetts Memorial Hospital, Boston, Massachusetts (under Dr. A. S. Relman).

DR. N. F. JONES (*St. Thomas's Hospital, London*): some aspects of the phenomenon of 'escape' from (1) sodium-retaining steroids and (2) vasopressin—at the University of North Carolina, Chapel Hill, North Carolina (under Professor L. G. Welt).

DR. J. P. KNOWLES (*Medical Unit, University College Hospital, London*): folic acid–vitamin B_{12} interrelationships, with particular reference to absorption, daily requirements and elucidation of the biochemical mechanism—at the Albert Einstein Hospital, New York (under Dr. I. London).

DR. C. MAWDSLEY (*University Department of Neurology, Royal Infirmary, Manchester*): the anatomical pathways, physiology and disturbance of vibration sense in animals, normal people and patients with disseminated sclerosis—at the Harvard University Medical School, Boston, Massachusetts (under Professor D. Brown).

MEDICAL RESEARCH COUNCIL TRAVELLING FELLOWSHIPS

These fellowships, which have replaced the Rockefeller Travelling Fellowships, are intended for medical or scientific graduates of registrar or lecturer status resident in the United Kingdom, who have undertaken some training in research in clinical medicine, surgery or some other branch of medical science and who are likely to profit by a period of work at a recognized centre abroad before taking up appointments in higher teaching or research in the United Kingdom.

The following appointments were made by the Council for the academic year 1964–65:

DR. M. C. BRAIN (*Department of Medicine, Hammersmith Hospital, London*): experimental studies on the effects of necrosis and thrombosis of small blood vessels on red cells and platelets—at the Division of Haematology, Johns Hopkins Hospital, Baltimore, Maryland (under Professor C. L. Conley).

DR. C. D. HOLDSWORTH (*Medical Unit, Royal Free Hospital, London*): cellular mechanisms in intestinal transport—at the Department of Physiology, Harvard Medical School, Boston, Massachusetts (under Dr. T. H. Wilson).

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DR. A. H. G. LOVE (*Department of Medicine, Queen's University, Belfast*): experimental and clinical investigation of the fluid and electrolyte imbalances in cholera and of methods of therapy—at the US Naval Medical Research Unit, Taipei, Taiwan (under Captain R. A. Phillips) and the Gastroenterology Unit, Massachusetts Memorial Hospital, Boston, Massachusetts (under Dr. F. Ingelfinger).

DR. H. NEWEY (*Department of Physiology, University of Sheffield*): cellular processes and transfer mechanisms in the intestine—at the Biophysical Laboratory, Harvard University, Boston, Massachusetts (under Professor A. K. Solomon).

DR. V. PARSONS (*Medical Unit, Royal Sussex Hospital, Brighton*): effects of ionic calcium on the transfer of phosphate—at the Arthritis Unit, Massachusetts General Hospital, Boston, Massachusetts (under Professor S. Krane).

DR. T. H. WILLIAMS (*Department of Anatomy, University of Manchester*): neurobiology of experimental and spontaneous degeneration—at the Department of Anatomy, Harvard Medical School, Boston, Massachusetts (under Professor S. L. Palay).

SIR HENRY WELLCOME TRAVELLING FELLOWSHIPS IN MEDICINE

These fellowships, which have been made available through the generosity of the Wellcome Trustees, are of similar standing to the Medical Research Council Travelling Fellowships. They are open to medical and scientific graduates with research experience in any field of medical science, although—in accordance with the wishes of the Trustees—the subjects of physiology, biochemistry, pharmacology and tropical medicine are given preference.

The following appointments were made by the Council for the academic year 1963–64:

MR. J. G. GRAY (*Department of Surgery, University of Birmingham*): transplantation biology with particular reference to graft adaptation in tolerant animals—at the Massachusetts General Hospital, Boston, Massachusetts (Under Professor P. S. Russell).

DR. M. G. M. JUKES (*University Laboratory of Physiology, Oxford*): the descending control of afferent pathways, particularly those associated with flex or reflex—at the Department of Physiology, Gothenburg University, Sweden (under Professor A. Lundberg).

DR. N. H. KEMP (*Department of Haematology, St. George's Hospital, London*): the biology of cell lines with an abnormal genetic constitution and their cultural characteristics *in vitro*—at the National Cancer Institute, National Institutes of Health, Bethesda, Maryland (under Dr. Emil Frei).

DR. P. R. MACKENNA (*Department of Physiology, University of Glasgow*): problems related to the release from and uptake into storage sites of the sympathetic transmitter under various conditions—at the Karolinska Institutet, Stockholm, Sweden (under Professor U. S. von Euler).

DR. R. W. B. PENMAN (*Department of Medicine, University of Sheffield*): respiratory physiology and the chemical control of breathing—at the Johns Hopkins University, Baltimore, Maryland (under Dr. R. L. Riley).

The following appointments were made by the Council for the academic year 1964–65:

DR. MARY R. DANIEL (*Strangeways Research Laboratory, Cambridge*): comparison of the actions of nickel and cobalt on different tissues of the mouse and rat and investigation of possible factors involved in the maintenance of differentiation in cell lines *in vitro*—at the Division of Histology, Ontario Veterinary College, Guelph, Canada (under Dr. J. W. P. Gilman) and the Department of Microbiology, University of Michigan, Ann Arbor, Michigan (under Dr. D. J. Merchant).

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MR. R. P. GOULD (*Department of Histology, Middlesex Hospital Medical School, London*): cytochemical changes in acid phosphates and non-specific esterase in peripheral nerve undergoing Wallerian degeneration studied by electron microscopy—at the Department of Anatomy, Harvard Medical School, Boston, Massachusetts (under Professor S. L. Palay).

DR. N. MACLEAN (*Department of Zoology, University of Edinburgh*): nucleic acids in nuclei of *Tetrahymena* and other cells, and the relationships existing between nuclear and cytoplasmic RNA and DNA—at the Rockefeller Institute, New York (under Dr. Mirsky).

DR. G. MEACHIM (*Department of Pathology, University of Sheffield*): electron microscope studies of some presumptive secretory granules in various states of cartilage—at the Department of Animal Biology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia (under Dr. I. Gersh).

MR. J. L. PROVAN (*Surgical Unit, University College Hospital Medical School, London*): techniques of cardiac and vascular surgery—at the Cardiovascular Laboratories, Massachusetts General Hospital, Boston, Massachusetts (under Dr. G. Austen).

LILLY FOREIGN EDUCATIONAL FELLOWSHIPS

After nomination by the Council the following appointments were made by Eli Lilly and Company, Indianapolis, USA, to Lilly Foreign Educational Fellowships for the academic year 1963–64:

DR. D. T. D. HUGHES (*The London Hospital*): factors producing clubbing of the fingers, particularly intrapulmonary 'shunt' mechanisms—at the Cardiovascular Research Institute, University of California, San Francisco, California (under Dr. J. H. Comroe).

DR. R. SMITH (*Central Middlesex Hospital, London*): investigations in the general field of water and electrolyte metabolism—at the University of California Hospital and Medical Center, Los Angeles, California (under Professor M. E. Rubini).

No nominations were made by the Council for the academic year 1964–65.

UNITED STATES PUBLIC HEALTH SERVICE FELLOWSHIPS

In 1958 the National Institutes of Health of the United States Public Health Service inaugurated a programme of research fellowships for European scientists and invited the Council to nominate candidates from the United Kingdom. The fellowships are open to medical or scientific graduates, and preference is given to candidates who have completed a doctoral degree in one of the medical sciences and have shown outstanding research ability. After nomination by the Council, the following candidates were elected by the United States Public Health Service to fellowships for 1963–64:

DR. W. D. ALEXANDER (*University Department of Medicine, Western Infirmary, Glasgow*): iodine metabolism and thyroid disease—at the National Institutes of Health, Bethesda, Maryland (under Dr. Rall).

DR. C. R. BLAGG (*Department of Medicine, University of Leeds*): experimental work on the effect of dietary factors, amino acids and steroid hormones on nutrition and protein metabolism in acute renal failure—at the Department of Medicine, University of Washington, Seattle (under Dr. B. H. Scribner).

DR. J. M. HOSKINS (*Department of Bacteriology and Virology, University of Sheffield*): quantitative evaluation of some of the processes involved in poliovirus variation—at the Wistar Institute, Philadelphia, Pennsylvania (under Dr. H. Koprowski).

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DR. A. E. M. MCLEAN (*MRC Tropical Metabolism Research Unit, Jamaica*): the biochemical basis of ion transport, with special reference to the role of these mechanisms in cellular injury—at the Wistar Institute, Philadelphia, Pennsylvania (under Dr. J. D. Judah).

DR. J. G. SPRUNT (*Department of Therapeutics, University of St. Andrews*): some aspects of pituitary-adrenal function—at the University of Southern California, Los Angeles, California (under Dr. D. H. Nelson).

After nomination by the Council, the following candidates were elected by the United States Public Health Service to fellowships for 1964–65:

DR. M. H. EVANS (*Sherrington School of Physiology, St. Thomas's Hospital Medical School, London*): development of techniques for the investigation of muscle-spindle behaviour—at the Physiology Department, University of Utah, Salt Lake City (under Dr. E. Perl).

DR. N. L. JONES (*Department of Medicine, Postgraduate Medical School, London*): techniques used in the clinical investigation of cardiac and pulmonary disease—at the Cardiovascular Research Institute, University of California Medical Center, San Francisco, California (under Dr. J. H. Comroe).

DR. J. R. LEDSOME (*Department of Physiology, University of Leeds*): reflex and central control of respiration and of the cardiovascular system—at the Cardiovascular Research Institute, University of California Medical Center, San Francisco, California (under Dr. J. H. Comroe).

MR. J. H. P. MAIN (*Department of Oral Pathology, University of Edinburgh*): physiology and pathology of fibrous tissue with special reference to the periodontal membrane and eruption—at the National Institute of Dental Research, Bethesda, Maryland (under Dr. H. R. Stanley).

ALEXANDER PIGOTT WERNHER MEMORIAL TRUST FELLOWSHIPS IN OPHTHALMOLOGY AND OTOLOGY

These awards are provided from a special fund placed at the disposal of the Council by the trustees of the late Lady Ludlow under the terms of a bequest in memory of her son, to be used ' towards the prevention and cure of blindness and deafness in the United Kingdom and the British Empire, and in particular research in connection therewith by financing medical men and students within the Empire to study methods and practices in all countries of the world '. Reference is made elsewhere (pp. 110, 111 and 231) to the provision made by the Trustees for the support of research in ophthalmology and otology under the Council's auspices at centres in the United Kingdom.

The following appointments were made for the academic year 1963–64:

MR. R. A. MCNEIL (*Royal Victoria Hospital, Belfast*): the pathology of otosclerosis—at the Massachusetts Eye and Ear Infirmary, Boston, Massachusetts (under Professor H. F. Shuknecht).

DR. D. SEVEL (*St. John's Ophthalmic Hospital, Johannesburg*): ophthalmic pathology—at the Institute of Ophthalmology, London (under Professor N. Ashton).

The following appointments were made for the academic year 1964–65:

DR. A. J. BRON (*Department of Ophthalmology, Guy's Hospital, London*): extracellular fluid and its removal from the orbit in animals and man—at the Wilmer Institute, Johns Hopkins Hospital, Baltimore, Maryland (under Professor A. E. Maumenee).

DR. PILLOO P. HAKIM (*ENT Department, Dudley Road Hospital, Birmingham*): microsurgery of the ear with special reference to operations for the relief of deafness of otosclerotic origin—at the National Hospital for Nervous Diseases, Queen Square, London (under Sir Terence Cawthorne).

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DOROTHY TEMPLE CROSS RESEARCH TRAVELLING FELLOWSHIPS IN TUBERCULOSIS

These fellowships, provided from an endowment by the late Mrs. Odo Cross, are awarded to suitably qualified British graduates who are devoting themselves 'to the advancement by teaching or research of the curative or preventive treatment of tuberculosis in any of its forms'.

The following appointment was made for the academic year 1963–64:

DR. W. HARTSTON (*The London County Council, The London Hospital and St. Thomas's Hospital, London*): tuberculin and other skin reactions in tuberculosis, sarcoidosis and leprosy—at centres in East and West Africa.

No award was made by the Council for the academic year 1964–65.

KATHLEEN SCHLESINGER RESEARCH FELLOWSHIP

This fellowship is provided from an endowment by the late Mr. and Mrs. Eugen M. Schlesinger in memory of their daughter, and is intended for research in the field of neuropathology. On the advice of the Fellowship Advisory Committee, preference has been given in recent years to candidates who propose to investigate mechanisms underlying degenerative processes affecting the brain. Dr. Clara Margoles was appointed to the Fellowship in January 1964 to investigate the fine structure of capillaries and their investments in the human foetal, neonatal and adult cortex and white matter. Dr. Margoles continued to work at the National Hospital for Nervous Diseases, Maida Vale, London, under Dr. W. McMenemey.

MAPOTHER BEQUEST RESEARCH FELLOWSHIP

This fellowship is provided from a benefaction by the late Mr. and Mrs. Edward Mapother for research in psychiatry. Miss Barbara C. Stevens was appointed to the fellowship in February 1963 to undertake an investigation concerned with the previous fertility of women who have reached the age of 50 years and who have had a psychotic illness not attributable to physical disease. Miss Stevens continued to work at the Institute of Psychiatry, Maudsley Hospital, London, under Professor Sir Aubrey Lewis and Professor D. V. Glass.

NATHAN TRUST FELLOWSHIP

In 1960 the Trustees of the Nathan Bequest for Cancer Research generously agreed to make funds available to the Council for the award of a fellowship to a British medical graduate who would undertake an investigation of bone sarcoma. Mr. D. R. Sweetnam (The Middlesex Hospital) was awarded this fellowship for a study of the prognosis in sarcoma of the lower limb, under the auspices of the Bone Sarcoma Working Party of the Council's Committee on Evaluation of Different Methods of Cancer Therapy.

CLINICAL RESEARCH FELLOWSHIPS

These fellowships, which are normally tenable for up to three years, are offered to suitably qualified medical graduates who wish to prepare for careers in clinical research. It is intended that each fellow appointed should have the

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opportunity, as part of his training, of studying methods of research in the basic subjects most relevant to his particular clinical interest, his training preferably being given in departments other than his own.

The following appointments were made for the academic year 1963–64:

DR. S. DUCKETT (*Maida Vale Hospital, London*): Department of Pathology, Postgraduate Medical School, London (under the direction of Dr. Everson Pearse).

DR. M. W. GREAVES (*St. John's Hospital for Diseases of the Skin, London*): Department of Pharmacology, University College London (Professor H. O. Schild).

DR. MORAG MCCALLUM (*Department of Pathology, University of Glasgow*): Strangeways Research Laboratory, Cambridge (Professor Dame Honor Fell).

The following appointments were made for the academic year 1964–65:

DR. BRENDA E. HIGGS (*Department of Medicine, Royal Free Hospital, London*): Department of Medicine, Postgraduate Medical School, London (Dr. E. J. M. Campbell).

DR. P. A. MURPHY (*Registrar, Radcliffe Infirmary, Oxford*): Department of the Regius Professor of Medicine, Radcliffe Infirmary, Oxford (Professor Sir George Pickering).

DR. P. RICHARDS (*Registrar, St. George's Hospital, London*): Department of Medicine, Postgraduate Medical School, London (Dr. O. M. Wrong).

DR. R. SUMMERLY (*Registrar, St. Thomas's Hospital, London*): MRC Unit for Research on the Experimental Pathology of the Skin, University of Birmingham (Dr. C. N. D. Cruickshank).

MR. P. VIG (*Institute of Dental Surgery, London*): Department of Orthodontics, Institute of Dental Surgery, Eastman Dental Hospital, London (Professor C. F. Ballard).

DR. J. L. WILKINS (*Registrar, St. Mary's Hospital, London*): Paediatric Research Unit, Guy's Hospital Medical School, London (Professor P. E. Polani).

JUNIOR RESEARCH FELLOWSHIPS

These fellowships, which are normally tenable for up to three years, are intended primarily for medical graduates who have completed their pre-registration hospital appointments, or for young dental graduates of similar standing; the awards are also open to science graduates with postgraduate degrees who wish to have a further period of specialized research experience. The fellowships are tenable in the departments in which the candidates are already working or at other suitable centres.

The following appointments were made for the academic year 1963–64:

MR. B. K. B. BERKOVITZ: Department of Zoology, Royal Holloway College, London (under the direction of Professor P. M. Butler).

DR. L. H. BLUMGART: Department of Surgery, University of Sheffield (Professor H. L. Duthie).

DR. J. L. BOAK: Department of Surgical Science, University of Edinburgh (Professor M. F. A. Woodruff).

DR. D. P. BRENTON: Medical Unit, University College Hospital Medical School, London (Professor C. E. Dent).

DR. B. CADDY: Department of Pharmacy, University of Strathclyde, Glasgow (Dr. M. Martin-Smith).

DR. D. J. COVE: Department of Genetics, University of Cambridge (Professor J. M. Thoday).

DR. W. T. DRABBLE: Lister Institute of Preventive Medicine, London (Dr. B. A. D. Stocker).

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DR. D. R. FORSDYKE: Department of Biochemistry, University of Cambridge (Dr. A. Korner).

DR. M. GURR: Department of Medical Biochemistry and Pharmacology, University of Birmingham (Dr. G. Hübscher).

DR. J. R. HENDERSON: Department of Neuropathology, Institute of Psychiatry, London (Professor P. M. Daniel).

DR. BRENDA E. HIGGS: Department of Medicine, Postgraduate Medical School, London (Dr. E. J. M. Campbell).

DR. N. MCINTYRE: Department of Medicine, Royal Free Hospital School of Medicine, London (Professor S. Sherlock).

DR. R. MORRISON: Department of Dermatology, University of Newcastle upon Tyne (Professor J. T. Ingram).

DR. P. A. RILEY: Department of Dermatology, University College Hospital Medical School, London (Dr. A. Jarrett).

DR. CATHERINE W. RINTOUL: Department of Experimental Medicine, University of Cambridge (Professor R. A. McCance).

DR. B. D. ROSS: Microbiological Unit, Department of Biochemistry, University of Oxford (Professor Sir Hans Krebs).

MR. I. M. SHAPIRO: School of Dental Surgery, University of Liverpool (Professor R. L. Hartles).

DR. D. J. C. SHEARMAN: Department of Therapeutics, University of Edinburgh (Professor R. H. Girdwood).

DR. I. C. B. STAMP: Metabolic Unit, St. Mary's Hospital Medical School, London (Dr. V. Wynn).

DR. JANET L. TAYLOR: Department of Colloid Science, University of Cambridge (Dr. D. A. Haydon).

DR. M. THOMAS: Cardiovascular Research Group, Postgraduate Medical School, London (Dr. J. P. Shillingford).

DR. A. WAKELING: Department of Anatomy, University of Birmingham (Dr. A. M. Mandl).

DR. J. K. WALES: Department of Pharmacology, University of Leeds (Professor D. R. Wood).

DR. A. R. WILSON: MRC Environmental Radiation Research Unit, Leeds (Professor F. W. Spiers and Dr. P. R. J. Burch).

The following appointments were made for the academic year 1964–65:

DR. T. G. BAKER: Department of Anatomy, University of Birmingham (Dr. A. M. Mandl).

DR. A. J. BARRETT: Strangeways Research Laboratory, Cambridge (Professor Dame Honor Fell).

DR. M. C. BROWN: University Laboratory of Physiology, Oxford (Dr. P. B. C. Matthews).

DR. R. COLEMAN: Department of Medical Biochemistry and Pharmacology, University of Birmingham (Dr. J. B. Finean).

DR. B. COLLIER: Department of Pharmacology, University of Cambridge (Dr. J. F. Mitchell) and Department of Physiology, McGill University, Montreal, Canada (Professor F. C. MacIntosh and Dr. R. I. Birks).

DR. A. Q. GARDINER: Department of Mental Health, University of Aberdeen (Professor W. M. Millar).

MR. M. H. HOBDELL: Department of Dental Prosthetics, London Hospital Medical College Dental School (Mr. S. F. Fish).

DR. L. H. HONORE: Department of Pathology, University of Edinburgh (Dr. D. L. Gardner).

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DR. P. F. KNOWLES: Department of Biochemistry, University of Oxford (Dr. D. E. Griffiths).

DR. PENELOPE J. LEACH: Department of Psychology, London School of Economics and Political Science (Dr. A. N. Oppenheim).

DR. CATHERINE M. U. MACLEAN: MRC Unit for Research on the Epidemiology of Psychiatric Illness, University of Edinburgh (Professor G. M. Carstairs).

DR. R. M. MARCHBANKS: Department of Biochemistry, ARC Institute of Animal Physiology, Babraham, Cambridge (Dr. V. P. Whittaker).

MR. R. PHILLIPS: Department of Psychology, University College London (Dr. R. J. Audley).

DR. C. E. POLKEY: Department of Physiology, University of Bristol (Dr. T. D. Williams).

DR. VALERIE A. RUCKLEY: Department of Pathology, University of Edinburgh (Dr. M. K. MacDonald).

DR. MARGARET E. SMITH: Department of Medical Biochemistry and Pharmacology, University of Birmingham (Dr. G. Hübscher).

DR. M. W. TURNER: Department of Experimental Pathology, University of Birmingham (Professor J. R. Squire).

DR. G. C. WEBSTER: Department of Zoology, King's College, London (Dr. L. Wolpert).

FRENCH EXCHANGE SCHOLARSHIPS IN MEDICAL SCIENCE

These awards are made in collaboration with the Centre National de la Recherche Scientifique and allow for the annual exchange of two workers from each country for a full academic year.

The following French scholars were nominated by the CNRS for awards to be held in Great Britain during the academic year 1963–64:

MME. C. ISRAEL (*Centre National de la Recherche Scientifique, Paris*): ARC Institute of Animal Physiology, Babraham (under the late Sir John Gaddum).

M. M. ISRAEL (*Centre National de la Recherche Scientifique, Paris*): ARC Institute of Animal Physiology, Babraham (under Dr. V. P. Whittaker).

No French scholars were nominated by the CNRS for awards to be held in Great Britain during the academic year 1964–65.

The following scholar was nominated by the Council for an award to be held in France during the academic year 1963–64:

DR. A. P. HOPKINS (*Guy's Hospital, London*): Salpetrière Hospital in Paris (under Professor Garcin).

The following scholar was nominated by the Council for an award to be held in France during the academic year 1964–65:

DR. L. DALGARNO (*National Institute for Medical Research*): Institute de Biologie Physico-chimique, Paris (under Dr. Francois Gros).

SCHOLARSHIPS FOR TRAINING IN RESEARCH METHODS
AWARDS FOR FURTHER EDUCATION IN THE MEDICAL SCIENCES
AWARDS TO MEDICAL STUDENTS FOR INTERCALATED COURSES IN A BIOLOGICAL SCIENCE

Scholarships are awarded to recent medical, dental or scientific graduates of special promise who wish to be trained in research techniques in order to pursue a career in medical research.

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Awards for Further Education in the Medical Sciences are made to enable graduates with a medical or dental qualification or a first degree in science to receive approved postgraduate instruction—as distinct from training in research methods—in a subject ancillary to their main research interest in the field of the biological or medical sciences.

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One hundred and thirty-eight new scholarships and awards were made for the academic year 1963–64 and the total number of awards held during that academic year was 265. One hundred and seventy-six new scholarships and awards were made for the academic year 1964–65 and the total number of awards held during that academic year was 346. The numbers of awards for each year according to subject were as follows:

Subject studied	*Number of awards* 1963–64	1964–65
biochemistry	76	99
physiology	35	45
pharmacology	24	31
psychology	20	30
microbiology	17	21
anatomy	16	20
radiation	12	9
biophysics	8	12
genetics	8	16
zoology	6	11
biology	5	5
endocrinology	5	4
chemistry	4	6
immunology	4	4
psychiatry	4	2
virology	3	3
bacteriology	2	2
pathology	2	8
social and environmental health	2	3
tropical medicine	2	4
dental science	1	3
history of science	1	1
internal medicine	1	1
special senses	1	1
nutrition	—	2
sociology	—	1
unclassified	6	2

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Scholarships and awards for further training were held at the following centres:

	1963–64	*1964–65*
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Birmingham University	28	30
Bristol University	2	5
Cambridge: University	32	34
MRC Laboratory of Molecular Biology	6	9
Strangeways Research Laboratory	1	—
Cardiff: University College of South Wales and Monmouthshire	5	7
Edinburgh University	9	18
Glasgow: University	18	16
University of Strathclyde	—	4
Hull University	4	6
Leeds University	6	7
Leicester University	3	6
Liverpool University	6	11
London: University		
Bedford College	2	2
Birkbeck College	2	1
Imperial College of Science and Technology	2	2
King's College	4	9
London School of Economics and Political Science	3	3
Queen Elizabeth College	3	4
Royal Holloway College	1	1
School of Pharmacy	4	4
University College	27	35
Charing Cross Hospital Medical School	4	3
Guy's Hospital Medical School	2	1
London Hospital Medical College	1	2
Middlesex Hospital Medical School	3	1
Royal Dental Hospital	—	1
Royal Free Hospital School of Medicine	4	2
St. Mary's Hospital Medical School	—	1
St. Thomas's Hospital Medical School	1	1
British Postgraduate Medical Federation		
Institute of Cancer Research	1	5
Institute of Psychiatry	6	7
London School of Hygiene and Tropical Medicine	2	5
Lister Institute of Preventive Medicine	1	1
Chelsea College of Science and Technology	3	7
Sir John Cass College	—	1
MRC Microbial Genetics Research Unit	3	1
National Institute for Medical Research	—	1
Loughborough College of Technology	—	1
Manchester University	—	4
Newcastle upon Tyne University	2	4
Nottingham University	3	5
Oxford University	44	55
Reading University	1	1
Sheffield University	8	10
St. Andrew's University	1	—
Southampton University	—	4
Swansea: University College	—	1

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Anti-depressant Drugs in General Practice

Occupational Health

J. C. Gilson, O.B.E., M.B., F.R.C.P. (*Chairman*)
Professor W. M. Arnott, T.D., M.D., F.R.C.P., F.R.C.P.E.
J. M. Barnes, C.B.E., M.B.
J. P. Bull, M.D.
W. R. S. Doll, O.B.E., M.D., D.Sc., F.R.C.P.
D. E. Hickish, Ph.D., A.M.I.E.E.
Professor C. R. Lowe, M.D., Ph.D., D.P.H.
L. G. Norman, C.B.E., M.D., B.Sc., F.R.C.P., D.P.H.
I. M. Richardson, M.D., Ph.D., F.R.C.P.E., D.P.H.
J. M. Rogan, M.D., F.R.C.P.E., D.P.H.
Professor R. S. F. Schilling, M.D., F.R.C.P., D.P.H., D.I.H.
Professor J. R. Squire, M.D., F.R.C.P.
W. H. Walton, B.Sc., F.Inst.P.
Professor J. S. Weiner, Ph.D., M.R.C.S.
P. J. Chapman, M.B. (*Secretary*)

Panels:

Measurement and Composition of Dust
Biological Activity of Dust
Decompression Sickness

Research on the Toxicity Testing of Drugs

Sir Charles Harington, K.B.E., Sc.D., F.R.S. (*Chairman*)
J. M. Barnes, C.B.E., M.B.
Professor J. D. Boyd, M.D., F.L.S.
Professor G. A. H. Buttle, O.B.E., M.R.C.S.
Sir James Cook, D.Sc., F.R.I.C., F.R.S.
Dame Honor B. Fell, D.B.E., D.Sc., F.R.S.
Professor A. C. Frazer, C.B.E., M.D., D.Sc., F.R.C.P.
R. Goulding, M.D.
Professor R. B. Hunter, M.B.E., M.B., F.R.C.P.E., F.R.C.P.
Professor W. L. M. Perry, O.B.E., M.D., D.Sc.
Professor M. L. Rosenheim, C.B.E., M.D., F.R.C.P.
Professor A. Wilson, M.D., Ph.D., F.R.C.P.G.
T. S. Work, D.Sc.
D. R. Bangham, M.B. (*Secretary*)

Dental

Professor M. A. Rushton, C.B.E., M.D., F.D.S.R.C.S. (*Chairman*)
Professor Sir Robert Bradlaw, C.B.E., D.D.S., F.R.C.S., F.D.S.R.C.S.
Professor A. I. Darling, D.D.Sc., M.R.C.S., F.D.S.R.C.S.
Professor A. D. Hitchin, D.D.Sc., F.D.S.R.C.S.E.
Rear Admiral W. Holgate, C.B.E., L.D.S.R.C.S.
G. N. Jenkins, Ph.D.
Professor R. Knox, M.D., F.R.C.P.
Professor N. H. Martin, B.M., B.Sc., M.R.C.P., F.R.I.C.
Professor A. E. W. Miles, M.R.C.S., F.D.S.R.C.S.
Professor G. L. Montgomery, C.B.E., T.D., M.D., Ph.D., F.R.C.P.G.
Professor H. G. Radden, D.D.Sc., F.D.S.R.C.S.
Professor B. Cohen, D.D.S., M.D.S., H.D.D. (*Secretary*)

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Army Personnel Research

Professor J. R. Squire, M.D., F.R.C.P. (*Chairman*)
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Professor W. J. H. Butterfield, O.B.E., B.M., F.R.C.P.
Sir Walter Cawood, K.B.E., C.B., Ph.D.
Professor G. C. Drew, M.A.
Lt.-Gen. Sir Robert Drew, K.C.B., C.B.E., Q.H.P., M.B., F.R.C.P.
O. G. Edholm, M.B., B.Sc.
Lt.-Gen. Sir John Hackett, K.C.B., C.B.E., D.S.O., M.C.
Lt-Gen. Sir Charles Jones, K.C.B., C.B.E., M.C.
Professor P. L. Krohn, B.M., F.R.S.
Maj.-Gen. D. B. Lang, C.B., D.S.O., M.C.
Maj.-Gen. W. D. M. Raeburn, D.S.O., M.B.E., M.A.
Professor M. L. Rosenheim, C.B.E., M.D., F.R.C.P.
R. C. Norton, M.B., D.Obst.R.C.O.G. (*Secretary*)
F. E. E. Smith, M.B.E. (*Assistant Secretary*)

Royal Naval Personnel Research

Professor Sir Lindor Brown, C.B.E., M.B., M.Sc., F.R.C.P., F.R.S. (*Chairman*)
Professor W. Burns, M.B., D.Sc.
Professor K. W. Donald, D.S.C., M.D., D.Sc., F.R.C.P., F.R.S.E.
Professor G. C. Drew, M.A.
Surgeon Captain J. Glass, O.B.E., L.R.C.P., D.P.H., R.N.
Professor J. A. B. Gray, M.B.
Captain I. S. MacIntosh, D.S.O., M.B.E., D.S.C., R.N.
Professor R. A. McCance, C.B.E., M.D., Ph.D., F.R.C.P., F.R.S.
Surgeon Captain S. Miles, M.D., M.Sc., D.T.M. & H., R.N.
A. W. Ross, O.B.E., M.A., A.M.I.E.E.
Surgeon Vice-Admiral Sir Derek D. Steele-Perkins, C.B., C.V.O., Q.H.S., F.R.C.S., F.R.A.C.S., D.L.O.
N. A. B. Wilson, O.B.E., Ph.D.
R. C. Norton, M.B., D.Obst.R.C.O.G. (*Secretary*)
F. E. E. Smith, M.B.E. (*Assistant Secretary*)

Clinical Psychiatry

Professor Sir George Pickering, M.D., F.R.C.P., F.R.S. (*Chairman*)
E. J. M. Bowlby, M.D.
Professor A. L. Cochrane, M.B.E., M.B., F.R.C.P., D.P.H.
Professor Desmond Curran, C.B.E., M.B., F.R.C.P., D.P.M.
Professor Sir Austin Bradford Hill, C.B.E., D.Sc., F.R.S.
Professor Denis Hill, M.B., F.R.C.P., D.P.M.
Professor Sir Aubrey Lewis, M.D., F.R.C.P.
A. B. Monro, M.D., Ph.D., D.P.M.
W. Linford Rees, M.D., M.R.C.P., D.P.M.
J. A. Fraser Roberts, C.B.E., M.D., D.Sc., F.R.C.P., F.R.S.
Professor T. Ferguson Rodger, M.B., F.R.C.P., F.R.F.P.S., D.P.M.
Professor M. Roth, M.D., F.R.C.P.
E. T. O. Slater, M.D., F.R.C.P., D.P.M.
Professor Sir Edward Wayne, M.D., Ph.D., F.R.C.P., F.R.C.P.G.
Professor O. L. Zangwill, M.A.
P. Sainsbury, M.D., M.R.C.P., D.P.M. (*Secretary*)

Subcommittees:
Clinical Trials (Drugs in Psychiatry)
Psychopathic Personality
National Statistics of Mental Disorder

Epidemiology of Mental Disorders

Professor Sir Aubrey Lewis, M.D., F.R.C.P. (*Chairman*)
Eileen M. Brooke, M.Sc.
Professor G. M. Carstairs, M.B., F.R.C.P.E., D.P.M.
Professor A. L. Cochrane, M.B.E., M.B., M.R.C.P., D.P.H.
Professor D. V. Glass, Ph.D.
E. L. M. Millar, M.D., D.P.H.
Professor W. M. Millar, M.D., F.R.C.P.E.

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Professor Sir George Pickering, M.D., F.R.C.P., F.R.S.
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G. C. Tooth, M.D., D.P.M.
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Subcommittee:
Causes of Crime

The Human Factor in Railway Accidents

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D. E. Broadbent, Sc.D.
Professor D. Russell Davis, M.D., M.R.C.P., D.P.M.
O. G. Edholm, M.B., B.Sc.
Professor Sir Austin Bradford Hill, C.B.E. D.Sc., F.R.S.
Professor H. Kay, Ph.D.
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J. W. Whitfield, M.A.
Professor W. D. Wright, D.Sc., D.I.C.
P. J. Chapman, M.B. } (*Joint Secretaries*)
A. S. Fairbairn, M.B. }

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Sir Harold Himsworth, K.C.B., M.D., F.R.C.P., F.R.S. (*Chairman*)
Professor Sir Lindor Brown, C.B.E., M.B., M.Sc., F.R.C.P., F.R.S.
Professor J. R. Squire, M.D., F.R.C.P.
Air Marshal Sir Harold Whittingham, K.C.B., K.B.E., M.B., F.R.C.P., F.R.C.S.E.
R. C. Norton, M.B., D.Obst.R.C.O.G. (*Secretary*)

Biological (Non-medical) Problems of Nuclear Physics

(*Jointly with the Agricultural Research Council and the Natural Environment Research Council*)

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H. R. Barnell, Ph.D.
Professor G. E. Briggs, M.A., F.R.S.
R. F. Glascock, Ph.D.
Professor J. E. Harris, C.B.E., Ph.D., F.R.S.
A. W. Kenny, M.A., B.Sc., F.R.I.C.
J. F. Loutit, C.B.E., D.M., F.R.C.P., F.R.S.
A. S. McLean, M.B., D.I.H.
W. G. Marley, O.B.E., Ph.D.
R. Scott Russell, Ph.D.
Professor H. G. Sanders, Ph.D.
A. W. Stableforth, C.B., D.Sc., M.R.C.V.S., D.V.S.M.
E. B. Worthington, Ph.D.

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N. T. J. Bailey, D.Sc.
K. L. Blaxter, D.Sc., N.D.A.
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R. Scott Russell, Ph.D.
C. L. Smith, Ph.D.
Elizabeth Neale, M.B., B.A.
F. J. S. Culley, LL.B., B.Sc. } *Joint Secretaries*

Panel:

Radiobiological Research

UK National Committee of the British Commonwealth Collections of Micro-organisms

(*Jointly with the Science Research Council and the Agricultural Research Council*)

S. T. Cowan, M.D., Dip.Bact. (*Chairman*)
A. H. Cook, D.Sc., F.R.S.
W. A. Cuthbert, M.Sc.
J. J. Elphick, B.Sc.
R. E. Glover, D.Sc., F.R.C.V.S.
D. Rudd Jones, Ph.D.
R. A. Lelliott, B.A.
J. G. Savory, B.Sc.
J. M. Shewan, Ph.D., F.R.I.C.
S. P. Lapage, M.B., Dip.Bact. (*Secretary*)

Lighting and Vision

(*Jointly with the Advisory Committee on Building Research of the Ministry of Technology*)

W. J. Wellwood Ferguson, M.B., M.I.Min.E., F.I.E.S. (*Chairman*)
B. H. Crawford, D.Sc.
Professor W. F. Floyd, Ph.D., F.Inst.P., A.M.I.E.E.
Professor R. G. Hopkinson, Ph.D., M.I.E.E., F.I.E.S.
J. S. McCulloch, M.I.E.E., F.I.E.S., M.Cons.E.
D. L. Medd, O.B.E., Dip.Arch., A.R.I.B.A.
Professor R. C. Oldfield, M.A.
D. J. Petty, M.B.E., M.A., Dip.Arch., A.R.I.B.A.
R. A. Weale, D.Sc.
A. T. Welford, Sc.D.
Wing Commander T. C. Whiteside, M.B.E., M.B., Ph.D.
J. B. Collins, B.Sc., A.M.I.E.E., F.I.E.S.
E. M. B. Clements, M.B. } (*Joint Secretaries*)

Road Users

(*Jointly with the Ministry of Transport*)

J. P. Bull, M.D. (*Chairman*)
R. Adamson, O.B.E.
G. H. Baker
A. C. Beck
P. J. Chapman, M.B.
E. J. Davies, M.Sc., F.L.S.

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Professor D. Russell Davis, M.D., M.R.C.P., D.P.M.
A. M. Houghton
R. H. Macmillan, M.A., M.I.Mech.E.
L. G. Norman, C.B.E., M.D., B.Sc., F.R.C.P., D.P.H.
E. C. Poulton, M.B.
Group Captain R. G. Stone
A. G. P. Way
R. A. Weale, D.Sc.
A. T. Welford, Sc.D.
J. W. Whitfield, M.A.
A. E. Walker, A.Inst.P. (*Secretary*)

Joint Medical Research Council/Atomic Energy Authority Co-ordinating Committee for Radiobiological Research

Professor Sir Brian Windeyer, M.B., F.R.C.P., F.R.C.S., D.M.R.E., F.F.R. (*Chairman*)
Sir Charles Harington, K.B.E., Sc.D., F.R.S.
J. F. Loutit, C.B.E., D.M., F.R.C.P., F.R.S.
A. S. McLean, M.B., D.I.H.
Professor W. V. Mayneord, C.B.E., D.Sc., F.Inst.P.
Professor J. S. Mitchell, C.B.E., M.D., Ph.D., F.R.C.P., D.M.R., F.F.R., F.R.S.
E. E. Pochin, C.B.E., M.D., F.R.C.P.
Professor M. M. Swann, Ph.D., F.R.S.
F. A. Vick, D.Sc.
R. C. Norton, M.B., D.Obst.R.C.O.G. (*Acting Secretary*)

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APPENDICES

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Accounts of receipts and payments

RECURRENT

1962–63 £	*1963–64* £	*Receipts*	£	£
23,427	*29,030*	Balance 1 April 1964		32,455
5,501,000	*6,524,000*	Parliamentary grant-in-aid		8,151,000
		Contributions from Government Departments		
(296,493)	*(354,226)*	Ministry of Health	428,563	
(105,722)	*(140,011)*	Ministry of Overseas Development	102,779	
(54,100)	*(65,400)*	Ministry of Defence	68,840	
(11,614)	*(22,183)*	Others	26,731	
467,929	*581,820*			626,913
		Contributions from public bodies		
(38,787)	*(35,265)*	Regional health boards	43,675	
(3,407)	*(2,281)*	National Coal Board	991	
(9,747)	*(8,120)*	Others	7,271	
51,941	*45,666*			51,937
		Contributions from special grants		
(32,575)	*(52,725)*	World Health Organization	40,242	
(77,781)	*(70,295)*	Others	35,827	
110,356	*123,020*			76,069
28,855	*3,272*	Contributions from bequests, donations etc.		4,542
88,186	*103,582*	Miscellaneous receipts		104,302
£6,271,694	*£7,410,390*			£9,047,218

NON-RECURRENT

1962–63 £	*1963–64* £	*Receipts*	£
44,879	*4,670*	Balance 1 April 1964	—
358,000	*509,000*	Parliamentary grant-in-aid	602,000
68,625	*35,962*	Repayments for new buildings from Ministry of Health	7,905
29,937	*421*	Contributions from special grants	—
3,566	*18,895*	Other receipts	2,554
—	*43*	Balance 31 March 1965	—
£505,007	£568,991		£612,459

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for the year ended 31 March 1965

EXPENSES ACCOUNT

1962–63 £	*1963–64* £	*Payments*	£	£
		Administration		
(248,255)	*(276,946)*	Salaries and wages	329,165	
(118,298)	*(114,671)*	Other expenses	142,585	
				471,750
366,553	*391,617*			
		Central expenses		
(23,790)	*(52,073)*	Pensions, honoraria etc.	38,989	
(47,513)	*(75,237)*	Other expenses	72,560	
				111,549
71,303	*127,310*			
		National Institute for Medical Research		
(694,625)	*(778,323)*	Salaries and wages	913,092	
(285,327)	*(288,507)*	Other expenses	330,918	
				1,244,010
979,952	*1,066,830*			
		Research units and external scientific staff		
(2,432,138)	*(2,805,213)*	Salaries and wages	3,306,277	
(1,068,717)	*(1,291,344)*	Other expenses	1,442,624	
				4,748,901
3,500,855	*4,096,557*			
4,918,663	*5,682,314*	Total direct expenditure		6,576,210
746,410	*999,643*	Temporary research grants and training awards ..	1,517,096	
55,872	*118,687*	Grants to universities for research groups ..	254,982	
521,719	*577,291*	Special grants to institutions	671,018	
				2,443,096
6,242,664	*7,377,935*	Total expenditure		9,019,306
29,030	*32,455*	Balance 31 March 1965		27,912
£6,271,694	*£7,410,390*			£9,047,218

EXPENSES ACCOUNT

1962–63 £	*1963–64* £	*Payments*	£
—	—	Balance 1 April 1964	43
417,458	*481,286*	New buildings	460,121
82,879	*87,705*	Grants to university departments for special apparatus	149,707
4,670	—	Balance 31 March 1965	2,588
£505,007	*£568,991*		£612,459

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APPENDIX II

Major contributions received from government departments and other sources in the two years ended 31 March 1965

Source	*Purpose*
Ministry of Health ..	Division of Immunological Products Control (National Institute for Medical Research) for therapeutic testing; Blood Group Reference Laboratory; Blood Products Laboratory; part of the cost of the Radiological Protection Service; special surveys.
Ministry of Overseas Development (formerly Department of Technical Co-operation)	Contributions towards the cost of: MRC Laboratories, Gambia; Tropical Metabolism Research Unit, Jamaica; Trachoma Research Unit, London and the Gambia; Epidemiological Research Unit, Jamaica; Abnormal Haemoglobin Research Unit; other research in tropical medicine.
Ministry of Defence ..	Investigations proposed by Council's Royal Naval Personnel Research Committee and Army Personnel Research Committee.
Ministry of Pensions and National Insurance	Audiometric surveys in industrial environments.
World Health Organization	International Laboratory for Biological Standards; World Influenza Centre; International Blood Group Reference Laboratory; International Reference Centre for Respiratory Virus Diseases; trial of chemotherapeutic agents against tuberculosis (India); contributions for special investigations at several Council establishments.
Wellcome Trust	Fellowship awards and contributions towards the cost of the Laboratory of Molecular Biology and of the Tropical Metabolism Research Unit, Jamaica.
Alexander Piggott Wernher Memorial Trust	Fellowship awards and contributions towards the cost of the Wernher Research Unit on Deafness and of the Wernher Research Unit on Ophthalmological Genetics.
United States Public Health Service	Contribution for electron microscope for Biophysics Research Unit.
Association for the Aid of Crippled Children	Grants for investigations by the Social Psychiatry Research Unit and by the Epidemiological Research Unit, Jamaica.

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Benefactions

During the period covered in this Report, the Council have gratefully received the following funds from private sources:

		GRANTS
Rockefeller Foundation, New York	$40,000	Travelling fellowships
	£2,000	Research in X-ray crystallography of proteins
Alexander Pigott Wernher Memorial Trust	£41,000	Research in blindness and deafness
The Wellcome Trust	£23,000	Travelling fellowships
Association for the Aid of Crippled Children	£9,305	Investigation of effect of institutional life on normal children
	£7,200	Study of child growth and development
Government of Uganda	£4,700	Infantile Malnutrition Research Unit
World Council of Churches	£2,790	Infantile Malnutrition Research Unit
International Atomic Energy Agency	£1,751	Tropical Metabolism Research Unit
National Multiple Sclerosis Society	£1,165	Research in the relation of cerebrospinal fluid to nervous tissue
The Trustees of the Nathan Bequest	£1,000	Research fellowship
The Mary Kinross Charitable Fund	£500	Investigation of the problem of urinary calculi

PAYMENTS ON ACCOUNT OF BEQUESTS

The late Mrs. J. J. Tilson	£3,150	Research in lupus erythematosus or associated diseases
The late W. E. Leslie	£6,400	Research in multiple sclerosis and other disorders of the nervous system
The late V. W. R. Studd	£808	Research in coronary thrombosis
The late Mrs. A. S. Dennis	£500	Research in Parkinson's disease
The late Mrs. E. E. L. Clark (final payment)	£239	General purposes of medical research
The late Frederic Saunders (final payment)	£210	Research in cancer
The late C. E. W. V. Reynolds (final payment)	£208	General purposes of medical research
The late W. A. Randall	£100	Research in cancer

DONATIONS

G. Cornelius, London; The County School for Girls, Reigate, Upper Sixth Science; Diss Express 99th Birthday Charity Fund; M. G. Millward, Leek; Newby Women's Institute; The Misses Pritchard, Sudbury, Suffolk; Rotary Club of Gateshead; Mrs. R. Vickery, Cuckfield	General purposes of medical research
(*In memory of Mrs. D. Ekins*) Burral Brothers Ltd.; Relatives and friends; K. Simpkin, Birmingham	
(*In memory of Mr. Hill*) Banstead Methodist Church; C. W. Hughes, Banstead	
(*In memory of H. Howarth*) A. Clark, Altrincham; E. Ellidge, Rochdale	
(*In memory of Alan Jones*) M. and J. A. Russom, Blackpool	

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(*In memory of Mrs. Hilary Millman*) Honiton Parents' Club	General purposes of medical research
(*In memory of Mrs. Phyllis Nott*) Ripaults, Enfield (Staff Collection)	
(*In memory of Dorothy Russell*) Miss M. D. Russell, Ventnor	
(*In memory of Dr. Ernest Sparks*) Miss M. B. Goodden, London	
(*In memory of Alfred Belton*) Relatives and friends, Castlethorpe	Research in asthma
(*In memory of Kathleen Messenger*) E. J. Lewington, Slough; Mr. and Mrs. Messenger, Langley; Night Staff, Slough Telephone Exchange	Research in blood diseases
F. H. Wise, Bishop Auckland	Research in brain diseases
(*In memory of Jack Collyer*) Relatives and friends, Castlethorpe	Research in cancer
Civil Service Association, Mill Hill Branch; Mrs. Irene Greaves, London; Miss Grace Kyle, Coatbridge; Ministry of Defence, Chief Polaris Executive, Bath	
Mrs. W. Parry Williams, Amlwch Port, Anglesey	Research in cancer and heart diseases
Woman's Help Organization, Warwickshire	Research in cancer and leukaemia
Mrs. I. Donaldson, Glasgow	Research in coronary thrombosis
(*In memory of R. E. Boness*) National Benzole Co., London; R. O. W. and D. Tallack, London	Research in coronary and artery diseases
(*In memory of Mrs. E. E. Turner*) Relatives and friends; A. White, Chard	Research in heart diseases
(*In memory of W. Whitehurst*) Relatives and friends	
(*In memory of James Bunn*) Relatives and friends	
(*In memory of Mr. J. T. Biggadike*) Mrs. E. Larrington, Spalding	Research in kidney diseases
(*In memory of William Parry*) Relatives and friends	
Anonymous; James Allen's Girls' School, London; Boroughmuir Secondary School, Edinburgh; Mrs. S. Green, Edinburgh; High School for Girls, Burnley; Holy Trinity Mothers' Union, Roehampton; Open Group of Holy Trinity Church, Roehampton; E. F. Phillips & Sons Ltd. (Staff), Parkstone; Wycombe Abbey School	Research in leukaemia
A. J. Smith, Farnham; Stevenage Broadhall Evening Townswomen's Guild	Research in mongolism (Richard Harrison Memorial Fund)
Congregation, St. George's Hall, R.A.F. Changi	Research in muscular dystrophy
(*In memory of J. S. Clamp*) Relatives and friends	Research in upper motor neurone disease
(*In memory of Eric Rushton Orrell*) Miss M. E. Orrell, Manchester	Research in nervous diseases
Mrs. C. A. Proctor, London; Mr. E. F. Proctor, London; Mr. J. D. Proctor, Crowthorne; Miss M. D. Proctor, London	Research in psychiatry
Mrs. A. J. Dods, Tunbridge Wells (further donation); Mrs. E. Clayworth, Thorpe Bay	Research in rheumatism
Mr. and Mrs. G. M. C. Kemp, Weybridge	Research in toxaemia

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City of Leeds Training College; J. E. Jarman, Fareham	Research in tuberculosis 303
Jules F. Kisseadoo, London	Research in tuberculosis, cancer, rheumatism and mental diseases
(*In memory of Mr. Smith, Walton-on-Thames*) Relatives and friends	Research in ulcerative colitis
D. W. Turner, Mapperley (further donation) Udimore Women's Institute	Research in virus diseases
Mrs. E. K. Chaffey, London	For the work of the Common Cold Research Unit
David Fasken, San Francisco	For the work of the Mineral Metabolism Research Unit
(*In memory of Claude Loraine Tucker*) A. C. Adamson, Enfield; Mrs. Dorothy Clarke; Mr. and Mrs. D. J. T. Graves, Denham Village; Mrs. M. Lewis, Royston; Mrs. A. D. Spears, Harpenden; Miss R. A. Turner, Harpenden; Messrs Tucker & Edgar, London; Mrs. N. Wallis and Mr. R. and Miss Woodman, St. Leonards on Sea	For the work of the National Institute for Medical Research

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INDEXES

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Index to Main Subjects of Research Programme

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Index to Establishments

(91794) L 2

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Index to Committees

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Index to Personal Names

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