PORTFOLIO FOR HEALTH

The role and programme of the DHSS in health services research

PROBLEMS AND PROGRESS
IN MEDICAL CARE

SIXTH SERIES

ESSAYS ON CURRENT RESEARCH

GENERAL EDITOR: GORDON MCLACHLAN

Published for the
Nuffield Provincial Hospitals Trust
by the Oxford University Press
London New York Toronto
1971

Contents

Unless otherwise stated at the head of the paper contributors are staff members of the Department of Health and Social Security

Editorial

This special number of *Problems and Progress* owes its appearance to the invitation which was given by the Editorial Board of the Trust last year to the Department of Health and Social Security to write an essay for the fifth series, on their current policy with regard to financing and sponsoring health services research. It has been apparent for some years that the Department's role in this sector of activity in the United Kingdom has become pre-eminent, and indeed, particular reference was made to this in both the *Seventh* and *Eighth Reports* of the Trust. There must now be few research organizations or departments of universities of any standing concerned with any aspect of health services research and development which are not receiving some grant from the Department of Health and Social Security for research. It is appropriate, thus, for the Trust, which for many years has played a leading grant-making part in this sector, to seek, through its no less important publication endeavour, to present to a wider audience, the policy range and an up-to-date record of the programme of the Department. Only in this way will it be possible for other parties in this field, including the Trust, to determine their own policies; for the amount of money going into research sponsored by the Department is extremely high and represents a large slice of the slender human resources on which research and development depend.

In the event, the essay of the 10,000 words or so we originally commissioned soon proved to be inadequate; for the Department felt they could not do their programme justice without setting out the

particular policies in certain of the special areas of activity, as well as their policy in general.

The book is constructed in three parts, with a Preface by the Chief Medical Officer. The first is a general essay setting out the history of the last few years and the role conceived by the Department. The second sketches the policies being pursued in some thirty particular areas of interest; and the final part consists of a list and a brief account of ongoing research. The uniqueness of the volume is underlined in that it also records the names of the individuals in the Department involved in the overseeing of many of these studies; and the recent change in policy in the Civil Service to enable this to happen must be applauded. It thus has the attractive virtue of enabling those of us interested, if not intrigued, by particular policies being pursued, at least to get behind the facelessness of some general concept called 'the Department', and must make for healthier public relationships. At the same time one must also commend the courage of the Department in setting out such full accounts of its intromissions in research sponsorship. Some of these will no doubt provoke some criticism or grumbles from those who feel they have some special knowledge or understanding greater than is available at the top, or that they would know how to direct it better; but the important thing is that the Prologue, setting the scene to a play of classic proportions, is now assembled and can be studied.

For all that it may be criticized in part, the record is a remarkable one. As the Chief Medical Officer points out in his Preface, there is a long and proud history of Department-based research but the development of the present phase is only a relatively few years old. Indeed, the beginning of this era is still fresh in Trust history in as much as among the very first grants made from the special allocation reserved by the Ministry of Health in 1962 for health services research, was one towards the study in Wessex of subnormality, jointly sponsored and financed by the Trust.

* * *

Yet, while praising this remarkable effort, it might be as well to have regard to a number of questions which ought to be asked, in order to avoid the risk of misunderstandings and distortions which affect perspectives, and depreciate what is a major achievement, as well as hindering the development and refinement of a programme designed to improve health services.

Perhaps the first question is what mechanism is employed in the appraising of these grants? This is not to try to expose the necessarily private nature of critical review to vulgar inspection, but rather to ensure it is not too cosy, with all the resultant danger of a Gresham's Law for research.

The second is an extension of this, with a practical eye to the future —what mechanism is there for monitoring the progress and the quality of research?

The third has also to do with selectivity in a slightly different connotation—what nexus there is between the research-giving divisions in the Department, and the policy-making divisions?

The fourth, the answer to which is possibly more complex than it seems to many, is what is the policy with regard to the follow-up and implementation of research results? This is not to succumb to the over-simple assumption that results in the health services field can be directly implemented by some clear line management process at the operating level. On the contrary, what probably is most needed is a policy for further education designed to communicate knowledge gained from such research to all the professional sectors. This will undoubtedly require some special mechanism which does not yet exist.

These latter questions of course raise issues with regard to the logical sequence of assessment, publication, and dissemination of research findings; and if those of us who have faith do not believe these questions have altogether been overlooked by the Department of Health and Social Security, it might still be salutary to speculate about them publicly.

As has been noted in the more recent editorials of the Trust publications and in the *Seventh* and *Eighth Reports*, some special mechanism to provide critical review of ongoing research is generally necessary. Since most research involves a slow maturity, one hopes the next report of the Department of Health and Social Security on its research activities will have something profound to say about selection, monitoring, assessment, and publication, always, of course, subject to what is possible within the laws of libel!

Yet again there is another aspect which must not be overlooked especially at this time, when the future of all the existing research councils is under debate. To a large extent most of the research projects reported here are directed towards solving some problem either

concerned with the operation of health services at every level of management or immediately connected with the policies of the Department. Quite apart from what is now accepted as the traditional purposes and policies of the Medical Research Council, there is still a case for a range of research with strong service implications to be funded by a body which has not the direct operational responsibilities and obligations of the Department itself, but is seen to be unbiased, independent, and has a lively interest in medical care practice and its quality. Whether this role can be undertaken by a Medical Research Council still separate from the Department of Health and Social Security, is a matter which perhaps needs to be debated; but there are undoubtedly issues which need to be researched independently for the public weal; and the direction of which ought to be removed from the bureaucracy of a national health service and the political machinery which activates it. Is it not too much to urge the need for an enlightened Department of Health and Social Security, not as part of its own research activities, but as a matter of public policy to fund such a body which will have as its long-term objectives, the monitoring of quality and the protection of the public?

GORDON McLACHLAN

3 Prince Albert Road
May 1971

Preface

BY THE CHIEF MEDICAL OFFICER

The Department is grateful to the Nuffield Provincial Hospitals Trust for sponsoring this publication and thus making it possible to give some general indication of the range of an activity of the Department which has not hitherto been generally known. In fact the involvement of the Department of Health and Social Security in research in the health field goes back to the earliest days of the work of Simon under the Privy Council and the Local Government Board over a hundred years ago. There was then neither a government-sponsored Medical Research Council nor active research under university auspices. Simon and his colleagues were moving into a new field which meant that there was a research component in much that they did. They were employed either whole-time at £800 a year or for a daily sum of £3 when working on specific limited projects. Much of the work was concerned with the control of communicable disease and with sanitary circumstances, but even that was substantially exploratory against the background of ignorance at the time. The small fund which was placed at Simon's disposal for the support of particular research projects was therefore of considerable significance for pioneer work.

Eight of the medical officers at the Privy Council and Local Government Board in the last century became Fellows of the Royal Society. Some of them engaged in pioneer laboratory research, for instance in the application of chemistry to the elucidation of clinical phenomena a hundred years ago. Toward the end of the century one of them was the first to culture a virus, that of vaccinia in the incubating egg. The Government Lymph Establishment was not merely for

the production of vaccine lymph but also did much of the earlier work on improving the safety of the lymph by reducing bacterial contamination. The establishment of the Medical Research Council transferred the main influence elsewhere, but the Department maintained a Central Bacteriological Laboratory and a Chemical Laboratory. The former was the forerunner of the Public Health Laboratory Service and the work of Scott and Griffiths on typing of streptococci was undertaken there. Even as late as the mid 1930s, the Ministry's Chemical Laboratory produced a publication on problems of contamination of food by heavy metals derived from cooking utensils.

The Emergency Public Health Laboratory Service set up just before the Second World War was succeeded by the permanent Service administered by the Medical Research Council for the Department until 1960 and this took on the research role in communicable disease; the Service is financed by the Department and has always had a major commitment to research. A few years later the Clinical Research Board took over responsibility for another area in which some funds had been drawn from the Ministry of Health. All that then remained was participation in occasional special studies such as the aetiology of retrolental fibroplasia and the teratogenic effect of rubella in pregnancy. During the last eight years or so, the concern for research which was present in the Central Department at its establishment has been revived and a system of support for the investigation of various aspects of the provision of health care and the support of a variety of clinical studies of importance to the running of the service has been developed. An account of some of the work sponsored during these years is given in the following papers together with a complete list of current projects.

G. E. GODBER

PART I

The Department's role in research and development

R. H. L. COHEN

The Department's role in research and development

R. H. L. COHEN

It is fitting that this first account of the Department's role and activities in research and development should be published by the Trustees of the Nuffield Provincial Hospitals Trust. They were among the first to see that a National Health Service would have to concern itself with questions of planning and priorities for which a basis of special studies would be required going beyond the bounds of medical research in its traditional sense; and they played a leading part in opening-up the then novel field of 'health care' studies which is a hybrid of the medical and social sciences and operational research. This is now a central theme of the Department's own research programme, accounting for between a quarter and a third of the total expenditure of some £5·5 million a year on research and development.

The article which follows is concerned largely with this central theme though it also deals in less detail with the other aspects of the Health and Personal Social Services[1] programme. It is not a statement of official policy but a personal account from the viewpoint of some of those who have been most concerned with organizing the work. In the first part we shall try to give an idea of the general objectives of the programme and of its place, as we see it, in the national picture of research and development; and we shall describe its origin, growth, and current scope and outline its organization and finance. In the second part we give brief accounts of a selection of

1. No account is given here of the origins and development of research in the social security field, or of research activities related to the children's services were the concern of the Home Office until December 1970.

research activities to illustrate some of the interests and methods of approach. A list of current projects completes the picture.

One important section of the work, that on public health in its more restricted sense, was an original responsibility of the Ministry of Health and had for many years been running along well-established lines. Health-care studies, by contrast, were after fifteen years of the NHS still relatively uncharted territory with the areas of interest and the methods and standards hardly beginning to be defined. It was decided, therefore, that most projects should have a precise and practical relevance to the operations of the NHS, that is to better care of patients or better use of resources, within a time-scale of the next five to ten years; but that a limited number which could be expected to be particularly fruitful in the development of research methods, though more theoretical and taking rather longer to yield practical results, should also be supported. Inside this general framework of strong and realistic service implications, however, as the fields of interest and research activity have become better marked out, it has been possible to be more selective and to concentrate on areas of priority. These have been seen increasingly as problems of service innovation, integration, and rationalization, of discovering the effects of altering the balance between care in hospital and in the community at large, and of finding ways of measuring the outcome of care so that new patterns of provision and organization can be compared and contrasted with the traditional; special attention is being given to improving the care of the elderly, the chronic sick and handicapped, and other 'dependent' groups whose needs too easily take second place.

The Department's programme is, of course, only a minor element in the total research effort in the medical and allied social sciences and this is perhaps the place to consider the way in which its policy and programme are related to others and especially to those of the Medical Research Council as the main government agency for medical research in its widest sense. The role and approach of the MRC can best be distinguished from the Department's by reference to the principle on which the Council was set up. This was that a central research organization should be separate from the executive departments of government so as to be able to operate (in Christopher Addison's words at the time) with 'the widest possible freedom' to make new discoveries unconstrained by pressures to give precedence to 'those problems which appeared at the moment to be of the most

pressing practical importance' at the expense of more fundamental studies which might prove more valuable in the long run. The MRC's major concern is thus to select and encourage growing points in medicine and the allied sciences and it could hardly accept primary responsibility for applied research in health care on the scale and with the priority that the NHS is now seen to require without unbalancing its own programme and distorting its original purpose. Such research is a proper interest and responsibility, though in no sense a monopoly, of the Department itself and was in fact allotted to it, though this is often forgotten, as 'medical services' research in the original concordat with the MRC which was reaffirmed when the NHS was introduced. On the other hand, it remains essential for the wellbeing of this field of work that the MRC should play at least as active a part in it as in the past and should continue to set a standard of quality and independence against which the work of others can be judged. There is thus no hard and fast line between the Department's activities and the MRC's but an overlapping and increasingly coordinated interest; and the intimate collaboration that has existed between the two bodies since they were set up almost simultaneously some fifty years ago has recently been exemplified by the formation of a joint research unit in Epidemiology and Medical Care which is being set up in association with the MRC's Clinical Research Centre and the new district general hospital at Northwick Park, and by the provision of joint long-term support to the Addiction Research Unit at the Institute of Psychiatry. The Social Science Research Council, on the other hand, is still at an early stage of development and does not yet seem to receive many proposals from research workers bearing on health and personal social services. The SSRC recognizes that the Department needs the support of a research council in the social no less than the medical sciences and as its programme and facilities develop the possibilities of collaboration will no doubt be increasingly explored. With many of the charitable organizations there has long been a very close relationship and there have recently been important joint ventures not only with the Nuffield Foundation and the Nuffield Provincial Hospitals Trust but also with, among others, the Imperial Cancer Research Fund, the Wolfson Foundation, and the National Association for Mental Health. In equipment and supplies research and development the Department relies considerably on the resources of government defence institutes diversifying their activities,

notably the Atomic Weapons Research Establishment at Aldermaston and the Microbiological Research Establishment at Porton.

Origin, organization, and growth

The National Health Service Act, 1946, contained a clause which stated that 'without prejudice to the general powers and duties conferred or imposed on the Minister under the Ministry of Health Act, 1919, and the duties imposed on the Committee of the Privy Council for Medical Research under the said Act, the Minister may conduct or assist by grants or otherwise any person to conduct research into any matters relating to the causation, prevention, diagnosis or treatment of illness or mental defectiveness'. It was only in 1963/4, however, that the former Ministry of Health first began to support research and development in their present wider context and interpretation. Till then it had regarded its research responsibilities as limited to the field of public health and it is interesting that as late as 1960 this is all that is attributed to it in the Zuckerman report on *The Management and Control of Research and Development*. In addition, since 1958/9, the Health Department had also operated, following agreement with the MRC and on a small though growing scale, a decentralized scheme of grants for the support of minor projects of hospital-organized research. This and the work of the Public Health Laboratory Service are the only two departmentally supported activities mentioned in the reference paper on *Medical Research in Britain* published by the Central Office of Information in 1963. Otherwise, there was only a small discretionary fund, a relic of that at the disposal of Sir John Simon in the nineteenth century and latterly running at £2,500 per annum, which the Chief Medical Officer could use to initiate research. There was no central research organization and no general provision for research related to the running of the NHS.

By this time, a decade and more after the creation of the NHS, there had already been a good deal of informal criticism of the inability of the Health Department to look at its own activities and the distinction was drawn between a commercial organization with its incentive to innovation and improvement and a civil service department adjusting and controlling the status quo rather than planning development in the future. Outside experts, for example in

social medicine and medical statistics, expected research in aid of planning but did not perhaps fully realize then that they were the very people to do this. More formal criticism was contained in the Acton Society Trust's 1958 and 1959 reports, *The Central Control of the Health Service* and *Creative Leadership in a State Service*, which advocated the formation of a central intelligence unit.

The situation in the Department began to change in 1961. On the administrative side, methods of producing and using statistical indexes and other measures of efficiency had been in the forefront of consideration since the Government was presented with the report of the Guillebaud Committee of Inquiry into the Costs of the NHS in 1956; and in 1961 an additional administrative division had been set up, to co-ordinate and develop the work concerned with the organization of the hospital building programme and standards relevant to it, equipment and supplies, organization and methods, and the definition of standards of good practice in hospitals. With the division was associated an Advisory Committee for Management Efficiency in the NHS.

Each of the branches was charged with collecting, assessing, and disseminating to the hospital services information relevant to its field of reference; and each was soon inevitably engaged in organizing studies to collect the facts to support its function. In one branch, Organization and Methods, the Department had recruited or trained a headquarters unit which in addition to carrying out its own programme of studies guided the development of O & M work-study in the hospital service. In the others it was neither feasible nor desirable to recruit and deploy expert resources on a scale sufficient to tackle the array of problems that had been identified and approval was obtained from the Treasury in 1963/4 for the allocation of funds for 'operations research' (used here in its widest and non-technical sense) in the hospital service and for the 'assessment and development of hospital supplies and equipment'. The authorization of funds to support the already considerable developmental activity in building and engineering followed two years later. Similar moves in relation to the GP and local health and welfare services resulted in the allotment of funds for each in 1964/5. Meanwhile an initially parallel but quickly converging stream of activity had been flowing on the medical side. In 1962 a small medical research section was set up to explore the scope for service-orientated medical research under

Ministry organization and in 1963/4 the so-called CMO's fund was expanded to provide initial resources for this purpose. A further stimulus was given by the recommendations of the Heyworth Committee on Social Studies in the following year as a result of its findings that the total government support in 1953 for social research in universities and research organizations was little more than £100,000 of which about £20,000 was in health and welfare; and the Trend Committee of Inquiry into the Organization of Civil Science in 1963 also provided some encouragement to government departments to pursue a more active policy in research.

These activities began piecemeal and initially were all on a very small scale. In the first few years the aim was to create, as rapidly as possible in view of the late start, a sound research base for expansion. This had to be of a size relevant to the needs of the NHS but without contravening the principle that it is better to do a little well than a lot badly; and in the four years 1963/4 to 1966/7 expenditure on R & D rose to some £750,000 (excluding expenditure on locally organized research). At this point the Department reviewed the activities, and concentrated and strengthened its domestic organization for the second stage of development. An equipment Research and Development Committee was formed and other resources for R & D were placed under the joint management of the Medical Research Branch (now under Dr J. M. G. Wilson) and a branch (under Mr J. B. Cornish who had developed the work up to this stage) of the newly combined Statistics and Research Division of which Mr W. Rudoe became director. A departmental Research and Development Committee was set up with the function of keeping under review and advising on the programme as a whole.

In late 1968 the Ministries of Health and Social Security were amalgamated to form the Department of Health and Social Security and a common Statistics and Research Division was established under Mr Rudoe. The Department's functions in social security are the direct administration of the Acts and Regulations governing sickness and industrial injury payment, supplementary benefits, family allowances, etc.; a considerable amount of statistical research is carried on internally on the basis of routinely or purposefully collected data, and this is supplemented as necessary by special inquiries into the circumstances of particular groups in the community who would not otherwise be adequately covered. Although much of the activity in Social Security

is clearly separate in kind from that in Health and Welfare the merger of the two organizations has opened up the possibility of faster progress towards the integration of social security and other medical and social research so that, for example, in planning research into problems of elderly people it will be easier to pay proper regard to the interrelationship between pensions policy and the provision of residential accommodation and other services for the elderly. Already the scope of certain community surveys has been enlarged in this way.

This, then, in outline is the current pattern of the departmental arrangements for administering research and development in the Health and Personal Social Services field. In an executive department, however, the organization for research cannot be considered in isolation from its place in the administrative structure as a whole; it is a part of this and its usefulness will depend on its relationship to and with the other parts. Service research is at once an instrument and a corrective of administrative planning and action. Its purpose is to help to provide the framework within which service decisions are taken and their effects can be evaluated, and it makes its contribution by looking further ahead and more widely and deeply than is possible in the general work of a department. In this it resembles in function longer-term planning, with which it needs an especially close and complementary association, but it differs in method as Bertrand Russell's 'American' rat, which battles its way out of the maze by a process of trial and error (field studies), differs from his 'German' rat (planning) which sits down and evolves its escape out of its own inner consciousness. The association with executive branches also needs to be close if those in charge of research are to be alert to the questions troubling those intimately concerned with running the services and if administrators for their part are to learn the uses and limitations of service research, which is like a pair of spectacles offering clearer and longer vision and not like a magic wand to conjure up ready-made solutions and decisions.

Thus an organic relationship needs to exist, it seems to us, between service research and service planning and operation. This principle, which is the obverse of the argument behind the setting-up of the research councils, was implicit in the Haldane Report of 1918 on the *Machinery of Government* and in the memorandum presented to Parliament by Addison when the Bill to set up the Ministry of

Health was under discussion; and the present division of function and responsibility in research between executive departments and research councils which originated at that time has been the accepted pattern in this country ever since. Nevertheless, now that research into the running of the NHS is at last seriously under way, the suggestion is being made in some quarters that it should be detached from the responsible executive department and put in the hands of a new and independant Health Services Research Council.

There are several arguments that have given rise to this suggestion. Probably the most fundamental is the belief that a government department is bound to be subject to pressures of political and administrative expediency which put the independence and continuity of its research policy and programme at special risk. It would be unrealistic to deny that there is an inherent risk of this and indeed it is right that there should be political interest in the priorities for government-financed research; the right equilibrium is a delicate one and some formal machinery to protect it is probably necessary. Secondly it is quite reasonably held that the quality and balance of a departmental research policy and programme would be better assured if they were more open to independent scientific discussion and advice not only in retrospect but also and more importantly in the formative stage. Or again it is said that the research workers might be more on their mettle if they were accountable to a body more like a research council. These are all arguments which deserve to be treated with respect (though it may be said in parenthesis that even research councils and charitable foundations are subject to pressures and prejudices and their own inborn errors of metabolism!).

There are, however, some serious arguments on the other side which point to the need for the final say remaining in the hands of the responsible executive department. Most of these have already been mentioned and together they suggest that there is a strong case for carrying out applied research in close relationship with those who will be using the results, but there is also the fact that, unlike a research council or a charitable foundation which can pick and choose and stop at will, the Department must try to ensure that research is undertaken into the value and management of potential new advances and that it is started in good time and carried through; if it does not do so, public and professional opinion will force it to provide untried services which may well be ineffective and thus a waste of resources.

The arguments against a Health Services Research Council would not apply to the alternative possibility of associating outside experts as members of a Departmental committee responsible for reviewing and guiding the general strategy of the programme. This step would introduce a strongly independent and scientific influence and would have much to commend it provided that the committee limited its concern to broad questions of policy and principle and did not attempt to exercise control over detail. Without such self-restraint it would be bound to proliferate subcommittees and a bureaucratic machine which would inhibit action and initiative.

There are a number of other safeguards which can be incorporated in a system of departmentally run research. First, there is the collaboration and competition of other research bodies in the same field. Secondly, one can make regular use, as we have done, of independent experts and especially the advisory machinery of such bodies as the MRC and the royal colleges in guiding particular parts of the work. Thirdly, as will be seen later in this paper, advisory committees of independent experts have been associated with the special service developments part of the programme; and the work of the units and the larger programmes is similarly associated with advisory committees of which independent experts are members.

The paramount need for an executive department to establish from the outset unassailable credentials of quality and independence in research was always uppermost in our minds and would by itself have been enough to lead us to try to place most of the work extramurally in departments of acknowledged reputation. Under these arrangements a variety and quality and independence of thought would be brought to bear on NHS problems which could not be enlisted in any other way. Moreover the possibility was opened further ahead of secondments or part-time appointments between research centres and the Department to their mutual benefit and education in each other's problems and ways of thought.

Fortunately, there already existed, at least in medicine, research workers with a spontaneous interest in practical health service questions, together with scientific journals able to assess and disseminate research results and a profession accustomed to combining an interest in research matters with a responsibility for providing a service. Nevertheless, even in medicine serious difficulties could be foreseen. Although this country had been the cradle of social medicine, there

was already a serious shortage of workers in this field and the promotion on any useful scale of health service research was bound temporarily to aggravate this. It was generally agreed, however, that the fault lay mainly in the current poor career prospects in social medicine and epidemiology and it seemed reasonable for the Department to help in tiding over this difficult transitional period by providing support for some additional good jobs in different places; the experience of the MRC in stimulating a more general interest in research in human genetics, for example, encouraged this view. In any event the theoretical alternative of concentrating support on a National Institute of Hygiene, on the pattern of some countries, was never a serious possibility. A. number of centres with the necessary skills already existed or were in process of being formed; they wanted to extend their work into the health service field; they needed support for this; and this seemed the best way of meeting the Department's needs. Services have to be studied *in situ* and both research and experiments need the whole-hearted local support which local research teams are often best able to secure.

In the social sciences, and in management and operational research studies, research was more difficult to develop and it was inevitable that the Department's early research projects should have been so largely medically orientated. The SSRC had not yet been set up; academic departments were relatively new and, with some important exceptions, an interest in health and welfare had still to be awakened; research techniques were also less well established and were difficult to apply in our field. It was necessary first to identify and cultivate those, besides the few pioneers, who might have a contribution to make; that was bound to take time but a substantial programme is now under way as the list of studies shows. (Economists proved the shyest birds; the example of Feldstein had not been followed and it was not until early 1970 that it was possible to arrange a conference under Professor Alan Williams at the University of York to discuss what part they might usefully play.) A small in-house Social Science Research Unit was formed in 1967 to help to develop and supplement the extramural activity; this Unit has produced several studies of its own including *The Multiple Health Screening Clinic, Rotherham 1966: A Social and Economic Assessment*, and *Nursing Attachments in General Practice*.

In the event, virtually all the Department's early research work was extramural except in building and engineering and in artificial

limbs where the Department's direct responsibility for providing the service led to its setting up its own Biomechanical Research and Development Unit. There is no finality in such a balance, however, and the in-house activity has grown recently by the recruitment of a team of operational research workers in the technical sense of the term. The need for this had been accepted for some time but finding the staff did not prove easy.

Scope and scale

The position at the present time is that the Department initiates and supports research and development in the medical and social sciences for purposes directly relevant to the operations of the NHS and the Personal Social Services; in the investigation and evaluation of techniques, forms, and patterns of delivery of medical and social care; in new and improved medical equipment, supplies, and patients' appliances; in hospital and other health building and engineering; in relation to its traditional responsibilities for surveillance of the public health; and in aid of social security. It also supports a locally organized research scheme open to all parts of the service and of increasing importance especially to the staff of non-teaching hospitals.

The financial scale of these activities, apart from social security research, can be seen in the Table. If the scale seems small in relation to

Table. 1970/1 (£1,000)

			Revenue		*Capital*
Medical, social scientific, and operational	Research		1,050		
	Development	hospital	500	550 = 1,600	600
		community	50		
Equipment, supplies, and appliances			1,400		
Building and engineering			680*		
Public health			400†		
Locally organized clinical research			940‡		
			5,020	= 5,620	600

* This is the expenditure on externally commissioned work only, in connection with the building system projects described on pp. 205–211 of Part II, and general research. The salaries of internal staff, and other expenditure on the projects and those of regional hospital boards are not included. The true cost of this R & D is probably about £1 million.

† Expenditure on research in public health cannot be accurately estimated (see p. 17).

‡ The scheme for locally organized research operates under separate procedural and funding arrangements (see Part II, p. 221).

the cost of the NHS it must be remembered that the Department's programme is only a minor element in the total of relevant R & D, which includes the larger contributions from the universities, the research councils, the charitable organizations, and industry. About a third of the revenue expenditure (excluding that on locally organized research) is on development or service experiments rather than on research proper and this needs to be borne in mind when comparing the Department's expenditure with other more strictly research programmes.

MEDICAL, SOCIAL SCIENTIFIC, AND OPERATIONAL

This first part of the programme, amounting currently to £1·6 million revenue and £0·6 million capital, includes R & D in all parts of the NHS—hospitals, general practice, local health and personal social services—but much of it, aiming at a fully integrated service, is concerned with the interrelationships between the parts. It involves a wide range of disciplines, including laboratory and clinical medicine and epidemiology, the various social and management sciences, and economics.

About 25 per cent of the £1·05 million revenue expenditure on research proper is on single projects, most of which are suggested from outside. The rest is on some forty programmes of approved linked projects, or for work by research units set up with broader terms of reference and for up to seven years to deal with particular subjects (e.g. drug addiction) or to bring particular skills to bear on NHS problems. Programmes and units have mostly arisen on the initiative or encouragement of the Department itself and the development of such expert reference points in different aspects of health and welfare has been the main means of enabling the Department to expand its research resources rapidly and to allocate the greater part on a broad plan of priorities.

Units are set up in academic departments, hospitals, or other research centres and the staff are employees of the university or other parent organization and subject to its terms and conditions of service, the Department providing a guaranteed level of support for a given period of five to seven years under a formal contract with the host institution and the Director. The scope and content of a unit's work are guided by an advisory committee on which the Department is represented and which includes outside experts. Subject to

the Department's right to comment on a report in draft the normal freedom to publish at the Director's discretion is fully maintained.

There are currently eight such units: they include the Social Medicine and Health Service Research Unit under Professor Walter Holland, the Wolfson Institute of Biochemical Technology under Professor Whitehead, the Addiction Research Unit under Dr Griffith Edwards (jointly with MRC), the Unit in Epidemiology and Medical Care (jointly with MRC) under Dr T. Meade, the Institute of Biometry and Community Medicine under Professor Ashford and Dr Pearson, the Hospital Organization Research Unit under Professor Jacques, the Community Care Research Unit under Professor Newell and Dr Walker, and the Special Hospitals Research Unit under Professor Gibben.

The terms 'Developments' and 'Special Service Developments', as used in this paper, refer to services paid for directly by the Department out of R & D funds, at least in the first instance. Services are ordinarily provided wholly by boards with the delegated responsibility of deciding their own priorities in the light of local needs and circumstances. There are, however, a number of exceptional situations in which the Department needs to influence the introduction or development or content of services to a greater extent than is possible under the normal arrangements. This method of direct central funding, taking the development outside the local scheme of priorities as an aid to innovation or change or rationalization, has been used very sparingly and with the guidance of expert committees, but under these conditions it does seem to have been reasonably acceptable and effective and to have served the interests both of good standards of care and the economical use of resources. It can be particularly useful when a new service needs to be evaluated before a decision to encourage its general introduction. Such an empirical approach, despite the undoubted potential of operational research, is likely to be essential to the successful application of radical change in a system with the inherent stability of the NHS and experiments of this kind are likely to play an increasingly important part in the Department's R & D programme.

A number of examples, including experiments in integrated services for the mentally ill and the mentally handicapped which are in the planning stage, will be referred to in Part II of this volume.

However, this method has so far been used almost entirely for developments in the hospital service and it may be worthwhile naming a few of these so as to give an idea of the kind of circumstances in which it has seemed appropriate: dialysis for chronic renal failure in order to introduce the new service quickly and evenly throughout the country and in such a way as to fit in later with transplantation; renal transplantation in order to accelerate this development in centres with the special skills and facilities and to influence the number and distribution of centres so as to avoid waste of resources; choriocarcinoma because this rare cancer required only one or two national centres and full support could not reasonably be expected from the board in whose region or hospital they happened to be situated; drug addiction centres because this was found to be the only way to meet a social emergency quickly; leukaemia because there seemed a likelihood of major advances in the next five to ten years which would be enhanced if two or three specialized centres were set up; large-scale experiments to test the practical and economic consequences of technological innovations such as laboratory automation.

This method of funding is still under trial but it is worth restating the three principles under which it has been used: it is exceptional, it is under expert outside advice, and it operates by encouragement through special funding and not by fiat or veto.

MEDICAL EQUIPMENT, SUPPLIES, APPLIANCES

The work in this field, under Dr G. E. Gale the Director of Scientific and Technical Services, is aimed at stimulating or assisting the development of novel or improved equipment, the need for which has become apparent as the result of progress in medical science or the realization of which has become feasible because of advances in technology. As with the other parts of the R & D programme the primary purpose in this field is to serve the interests of the NHS in providing better care of patients and more efficient use of resources, but there is also in this case the secondary purpose that the Department, as the sponsoring authority for the medical equipment industry, has a responsibility to take into account the welfare of the industry and its contribution to the national economy. The fact that the R & D programme in its initial years has concentrated on hospital equipment and mainly on its more sophisticated elements is partly a reflection of this double responsibility.

The R & D work is carried out almost entirely as project research by other government R & D establishments, mainly of the Ministry of Defence or the former Ministry of Technology, by university departments or industry; and trials of technical and clinical effectiveness are undertaken in collaboration with hospitals and other health authorities. One extramural research unit has been established in this field, the Biochemical Technology Unit in Birmingham under Professor Whitehead, to develop, test, and study the clinical and operational uses of automated laboratory equipment, and to train technicians in its use; the possibility of other units in different sectors of the equipment field is under consideration. There is also a directly administered Biomechanical Research and Development Unit at Roehampton which is concerned with new and improved artificial limbs.

The current programme can be broken down broadly into the following groups: radiology, including ultrasonics and thermography; radiotherapy; patient-monitoring; pathology laboratory equipment; pattern recognition, for example for cervical cytology; intermittent haemodialysis apparatus; invalid transport; medical and surgical appliances and aids; implants and toxicity, and muscle stimulators; medical and dental supplies, for example, asparaginase; non-medical items such as cots, beds, and mattresses.

PUBLIC HEALTH

The research and development programme in public health covers such subjects as communicable diseases, including the development and safety-testing of vaccines, the development of biological standards for the control of drugs, the development of blood products, radiological protection, fluoridation of water supplies in which large-scale community trials have been carried out, and nutritional surveys of vulnerable groups of the population. This work is largely carried out through the agency of such bodies as the Public Health Laboratory Service, the National Radiological Protection Board, the MRC, and the Lister Institute of Preventive Medicine. Most of it is a mixture of research and service and, apart from a number of separately costed and approved projects, the figure for expenditure is a notional estimate of the proportion of time spent on research in these mixed activities, arbitrarily put in the Table at 10 per cent of the total.

BUILDING AND ENGINEERING

LOCALLY ORGANIZED RESEARCH

The activities in building and engineering and the locally organized research scheme are described on pp. 205 and 221 respectively, of Part II.

Balance, implementation, and future

We have now made a rapid review of the scale and scope of the Department's programme and it remains only to say something about its balance, implementation, and future. One question that is always being asked about a research programme is whether it represents a proper balance of effort. One cannot make any useful assessment of this simply by totting up the costs in particular parts of the programme and comparing them; they need to be seen in relation to all research activity in the field of interest. Again the figures may differ greatly in meaning in different parts of the field. Take that of public health, for example. This was the Department's earliest and is still its primary responsibility; if an urgent need arose there it would have to be given priority and work elsewhere sacrificed if necessary. Its apparent expenditure on research, however, as it appears in the departmental budget, is comparatively low. One reason for this has been the very substantial contribution which the MRC and other outside bodies have always made; a second is that there exists in this field large and highly expert organizations, notably the Public Health Laboratory Service and the National Radiological Protection Board, maintained predominantly to carry out a service but each engaged also in research as part of its normal day-to-day activities; the dividing line is arbitrary and at any time there is a potential for expansion in research which could be rapidly mobilized. Or, to take another example, the Department is the production or sponsoring authority for the medical equipment industry, that is to say its R & D programme has to be devised not only to meet the needs of the NHS but also with the wellbeing of industry and the effects on imports and exports in mind; clearly, the content of the work and its scale in relation to other parts of the programme will reflect this double preoccupation. But there is a general and more fundamental difficulty beyond all such particularities. An attempt should certainly be made, as is being done by the Science Research

Council and others, to find a more scientific yardstick to predict the return to be expected from different combinations of research investment, but the notion of an ideal balance which can be objectively arrived at is still a will-o'-the-wisp. Every research programme is a compromise between need and opportunity. One can do little more at present than try, with the best-informed advice that one can canvass, to anticipate at least some of the needs and opportunities. This is regrettably shallow but it is true. It is easier to judge a programme at the end by its foresight in capturing what appear in retrospect to have been the most important issues.

A further question that is commonly held to be especially relevant to government-supported research and experiment is whether proper steps are taken to ensure that the results are implemented. It is important that the results of departmentally sponsored research, as of research financed by other means, should be publicly and critically discussed and assessed in the light of all other relevant information, and that they should then be used appropriately. The research is usually published in the scientific press and presented at academic meetings and, deriving what authority it can from the work itself and the reputation of its authors, must then find its own level by competition in the commerce of the world at large. The principal role of the Department in this is to help to create the opportunity and machinery for discussion and consequent action, as for instance by subsidizing publication when necessary and encouraging meetings concerned with health services research. There is still a danger that results which have been judged to be valid and important in this way will not get fully disseminated to, or understood by, those who should use them in their work and the close links between those responsible for the research programme and those responsible for the service within the Department are very helpful in encouraging this process of dissemination and interpretation. The results of the research programme are only just beginning to be produced in any quantity and it will become increasingly necessary to make assessments of the results and application of the research. Consideration will also have to be given to the arrangements for the necessary critical review as well as the presentation and publication of the results.

A special problem arises with equipment research in which the Department may be responsible both for the development of specific products and for decisions on whether to arrange for bulk purchase.

The Department circulates to hospitals its own bulletin, *Hospital Equipment Information*, which contains not only summaries of the work but also recommendations. In one or two instances only, when expensive equipment such as the Medresco hearing aid has been made available on a national scale, it has been thought right to restrict development to an 'official' product but the formidable objections to such a course in any but the most exceptional circumstances are well understood. Official salesmanship, besides being likely to defeat its own object, would in a near-monopoly service multiply and extend the consequences of error.

There is only very little that can be said with assurance about the future. Whatever happens it is impossible for the Department to mark time in research. As we have already said, the Department in its planning and policy-making cannot leave research into the value and management of potential new advances to the chance interest of others with no service responsibilities. If it does shift the onus in this way and the work is not done in time, it will have to act in default of the evidence. Nor can the Department abdicate its responsibility for seeing that the public gets the aids and appliances it needs, for example artificial limbs, hearing aids, or invalid vehicles. It seems likely, however, that the next two or three years will be taken up on the health side more with consolidation and development of existing research resources than with expansion. The research programme has grown rapidly and the few staff have been occupied in building up the programme and an internal and external organization able to respond flexibly to different and changing needs; now more time needs to be spent in planning the general strategy and in the tactics of particular operations, in developing the exchange of information between research groups, and in learning how to mount and monitor the experiments needed to ensure that health services remain vigorous and adaptable. Thought will have to be given soon to what is the right-sized programme and organization to be aiming at in ten years time. It is impossible to be dogmatic about this but there is a lot to be said for so organizing research that its administration can remain the responsibility of a small group of people who share a common outlook, have become over the years familiar to the research world outside, and know how to preserve that speed and informality of dealing which are the marks of good research administration and tend to be lost as organizations grow bigger. A team of this kind must, of

course, make its aims and purposes known and be subject to advice and criticism both within and outside its own organization, and it must be able to call upon independent expert guidance. Growth beyond a certain point is difficult without the creation of an administrative machinery of some complexity and it may be wise to consider seriously the alternatives to continued growth of a central bureaucracy. One possibility would be to use the network of research units and programmes that is being built up to develop a regional administration of research. We shall see.

PART II

Selected activities and problems

EDITED BY GILLIAN R. FORD

Selected activities and problems

The subjects of the essays which comprise Part II of this volume have been chosen as a sample of the range of problems that have been tackled in the research programme. Inevitably it has not been possible to do each part of the programme equal justice, because much of the current activity is still at an early stage and is not ready to be described. This applies particularly in the social sciences because the conditions there were not so favourable for a quick start in research as they were in the field of medical care. Some subjects are included—fluoridation and the dental survey are two—reference to which will not be found in Part III which includes a list of all current projects because the research is complete or because, as with regular dialysis, financial arrangements are now on a different basis.

The essays have been written in the hope that they will be of interest to very different audiences, not only professional, and therefore technical language has been avoided as far as possible.

In the main they refer to complete or at least well-advanced programmes of research. The intention is to produce further reports, though on a smaller scale at regular intervals. Reports by individual investigators will of course continue to be published through the usual channels as the studies are completed. Work in the field of computers or social security is not described.

It will be appreciated that only research supported by the Department is described in any detail; other work is not discussed unless it has an important bearing on the current programme or was a forerunner to it and the sponsoring body or organization and the authors

are then named. Studies described in detail and carried out in this country are those for which departmental funds were used unless the text states otherwise. The list numbers included in parentheses in many of the essays refer to the corresponding entry in Part III.

The articles are signed by the authors and we are grateful to them for collaborating in the production of this volume and to many other people inside and outside the Department of Health and Social Security who have read drafts and made helpful suggestions.

Grateful acknowledgements are due to Mrs K. E. Brewer for her patience in typing and preparing drafts for publication.

GILLIAN R. FORD

1. Measuring need and evaluating services

G. K. MATTHEW

In the last few years the NHS has been increasingly challenged to base its planning on scientific information and analysis rather than on arguments from theory and established practice. An important long-term aim of the Department's research programme is to develop methods for obtaining such information and to establish the limits of what is practicable and economic in its provision. Formidable difficulties arise in much of this work and its practical importance is sometimes disputed; this is illustrated by the two subjects which will now be discussed, the measurement of the need for medical care in the community, and the evaluation of new ways of providing health services. Some people believe that these subjects present insuperable research difficulties or that the findings would never be used in practice, others that they are of crucial importance to the health service and that it would be very wrong not to arrange major research programmes centred on them. In scientific study there is no way of predicting when apparently insuperable difficulties will be resolved and difficult subjects must certainly be tackled if real advances are to be made in the creation of a scientific base for planning. The Department has therefore supported research into these two subjects, although on a limited scale. This work is designed to see whether the difficulties can be overcome by scrupulously thorough research and to ensure that any methods which are eventually proposed for routine service use are really soundly based.

Research into the need for medical care

DEFINITIONS

The 'need' for medical care must be distinguished from the 'demand' for care and from the use of services or 'utilization'. A need for medical care exists when an individual has an illness or disability for which there is effective and acceptable treatment or care. It can be defined either in terms of the type of illness or disability causing the need or of the treatment or facilities for treatment required to meet it. A demand for care exists when an individual considers that he has a need and wishes to receive care. Utilization occurs when an individual actually receives care. Need is not necessarily expressed as demand and demand is not necessarily followed by utilization, while, on the other hand, there can be demand and utilization without real underlying need for the particular service used.

BACKGROUND

Until recently health services have been planned on the basis of past utilization with some correction for unsatisfied demand as indicated, for example, by long waiting-lists. Even now such changes in the scale of provision as are planned are based on a more even distribution of resources across the country, or on anticipated changes in ways of dealing with existing demand, rather than on an accurate assessment of the total need for medical care.

In the years since 1948 there has been a gradual realization that the existence of unmet need forms an important and difficult problem. Doctors have always been concerned by the numbers of patients who present themselves for care late in the course of a disease but the expectation that the creation of the NHS would eradicate the problem was disappointed.

Indeed, an increasing number of surveys (1, 2) as well as studies of the prevalence of particular diseases, indicated the possibility of a considerable amount of unmet need due to overt disease, while a developing interest in presymptomatic disease and predisease states widened the field of concern; some of the evidence was reviewed by Last in his article on 'The Iceberg' (3).

There have also been advances, which have stemmed from some of these studies, in the research methods available for obtaining accurate

information during surveys, whether by questionary, physical examination, or clinical measurement. Statistical sampling techniques are now well established, while computers permit the processing of large quantities of data (4). It should therefore be possible to check on the earlier work and to extend it with increased confidence in the accuracy of the findings.

Some people have questioned the sense of searching for unrecognized need when the NHS has difficulty in coping even with the need which it does recognize. There are two ripostes to this. First, research on unrecognized need in the Department's programme is more than balanced by research on inefficient use of resources. Secondly, it is likely that some unrecognized need is more important than some need that is already met by the NHS. It is increasingly accepted that in an era of rapid technical advance and rising expectations, health services will be unable to do everything which is technically feasible, but it is also recognized that the right response to this situation of shortage is for doctors to establish priorities in medical care (2) and to do the most important things thoroughly. Knowledge of total need and therefore studies of need will be necessary for the establishment of rational priorities.

The Department therefore supports studies concerned with discrepancies between the amount of illness in the community and the utilization of services needed for the care of that illness. This work should establish whether there is indeed serious unmet need in the community and should identify the diseases and groups of people in which it is most important. It is hoped that in the longer run it will also lead to practical techniques for the regular monitoring throughout the country of important unmet need, for identifying the facilities required to meet the full need and thus for planning the service more accurately and appropriately than is at present possible. However, there are still many difficult questions to be resolved and complete success in meeting this wider objective is far from certain.

In the next pages descriptions of studies on samples of the general population will be followed by a discussion of difficulties which arise in the design and use of such studies. There are, of course, other ways of obtaining information on the need for care and the use of services. For example, samples of persons who are already receiving some form of care can be studied in order to determine whether that care is being given in the most appropriate sector of the NHS; a team from

the Department of Organization of Medical Care at the London School of Hygiene is developing studies designed to identify people who are nursed at home but who should be in hospital or are otherwise misplaced (5). Many studies supported by the Department are related to the general question of the selection of care which best meets the needs of the individual. Another approach is to extend the information on utilization already available from routine statistics. In a study undertaken at Exeter, Ashford and Pearson (6) have recorded the contacts which individuals in a study population have made with both general practice and the hospital service. These studies, however, raise questions which are technically different to those posed by the studies of need in the community and are not discussed further.

SOME RECENT RESEARCH

As part of an extended programme of research in the Liverpool area, Professor R. F. L. Logan and his colleagues undertook studies of the need for surgical care amongst the populations of Chester and Warrington.[1] Four conditions (hernias, varicose veins, haemorrhoids, and bunions), the presence of which should be clear to an affected person, were selected as 'indicators' of the need for elective surgical procedures as a whole.

Careful checks on the validity of the survey methods used have been shown to be necessary in this kind of work and were thoroughly undertaken on this occasion. Questions were asked on past events only within the time-limits for which recall has been shown to be accurate in the general population. Information was obtained from samples of the population on the presence of the conditions, treatment received, and the associated symptoms and disability. Co-operation was good. Subsamples were examined by each individual's GP to check on the accuracy of this self-diagnosis although these examinations were not standardized.

The studies found that a substantial proportion of the individuals in the study population reported symptoms, usually mild, which they

1. This programme has been supported by the Liverpool Hospital Boards and the Nuffield Provincial Hospitals Trust as well as by the Department. The surveys described here were associated with studies of health service utilization undertaken by Professor Logan as part of an international comparison fostered by the World Health Organization.

attributed to these conditions. Many self-assessments were inaccurate, judged by the medical examinations. The self-assessments and medical examinations agreed, however, that almost all of such untreated disease as there was, was so mild as not to constitute a need for treatment; the discomfort and inconvenience of an operation was not acceptable in view of the slight benefit to be expected from it. These studies showed the importance of taking account of severity and of prognostic outlook in studies of need. Conclusions could be drawn on this occasion about the conditions named but it was clear that they could not be extended to conditions which are less easy to detect or of a more serious character. For these it remained probable that standardized physical examination and measurement carried out by specially trained staff would be necessary.

Professor W. W. Holland and his colleagues[1] conducted a series of such studies in one London borough. Their surveys covered utilization as well as medically defined disease prevalence and most of them included standardized examination and measurement. The main conditions studied were chronic cardio-respiratory disease, skin disease, and duodenal ulcer together with functional disability due to any disease. In order to be certain of having really reliable samples of the population in an area with high migration rates, a special private census was undertaken, and the opportunity was used to compare results obtained on this basis with results obtained using more usual procedures. A questionary was sent to a sample of those listed and contained questions designed to indicate the possibility of the recipient having one of the four conditions. For each condition in turn subsamples were drawn and a more detailed assessment carried out, usually on a high proportion of those who had positive findings indicated by the screening questionary and a lower proportion of those who did not. In the case of the disability survey the assessment was by interview only, whereas with the other surveys selected standardized physical examination and measurement were included. The prevalence of each condition was stated in terms of closely defined degrees of severity. Social and psychological assessments

1. From the Health Service Research Unit in the Department of Clinical Epidemiology and Social Medicine at St Thomas's Hospital Medical School, London. The work has been supported by the Board of Governors of St Thomas's Hospital and by the South-west Metropolitan Hospital Board as well as by the Department.

were made in order to study the reasons for variations in the use made of the health services. Careful training was given to the individuals performing the assessments and full checks on the validity of the measures used and on inter-observer variations and 'observer drift' were carried out.

Some of the first results of these studies have recently been published (7, 8). It is clear that a great deal of information on disease prevalence and the use of services will be yielded by them, and important advances in research methods have been achieved. Professor Holland now intends to study the problem of how to state the discrepancy between measured ill-health and utilization of services in terms of the altered or additional facilities required to deal with this unmet need.

DISCUSSION

To plan the development of a health service on the basis of studies of need is an obvious enough idea. A series of very difficult problems is involved, however, which is why planning has not so far been done in this way and why a cautious approach has been adopted in the Department's research programme. To obtain valid information on disease prevalence for all parts of the country presents a group of problems which are primarily epidemiological; to use this information for planning the appropriate facilities presents clinical and planning problems, many of which have not yet been tackled. Some of these problems are listed below; the first four have already been extensively studied.

EPIDEMIOLOGICAL PROBLEMS

Measures of disease and disability. Measures which have been proved to be valid and accurate indicators of the presence of a particular condition but which are also suitable for use on healthy, busy people and sufficiently cheap, are even now available only for a limited range of conditions. It is encouraging that at least in the case of measures of functional disability questionaries have been developed which are as good as physical measures.

Problems with questionaries. People remember events, even those in their personal lives, with reasonable accuracy for astonishingly short periods. Interviewers need great skill, intense training, and careful

supervision if they are to obtain undistorted answers. Methods of using self-administered questionaries are being developed and validated and results are encouraging.

Selection of study population. Complete and up-to-date lists of a population accurate enough for scientific purposes have been thought to necessitate the use of a private census but this would be too expensive and time-consuming for routine use. Fortunately, Professor Holland's work has shown that drawing the study population from the Electoral Roll gives results which are valid when compared with those based on the use of a private census.

Obtaining an adequate response from the study population. It is important to obtain the co-operation of almost all of the population selected for study, since the non-responders are likely to be different from the rest of the population with respect to the characteristics being studied. Painstaking and expert public relations are therefore necessary, but in spite of every effort it may happen that too few people co-operate in the first instance. An intensive follow-up of the non-responders then becomes necessary in order to obtain results from a sufficient proportion of the population. An important recent development in technique has been to concentrate this follow-up on a random sample of the non-responders and to accept the initial results as valid if the results from the sample confirm them. If they do not it becomes necessary to follow up the rest of the non-responders:

Extrapolating local findings to a wider population. It is unlikely that studies of samples of the population in every district of the country and on a wide range of conditions will ever be practicable. The question therefore arises of whether the prevalence of disease in one population may be deduced from its prevalence in another; it may be that the prevalence is similar in different districts amongst subgroups of the population with similar personal and social characteristics who live and work in similar environments but it is unlikely that findings can be extrapolated to a wider population on the basis of the limited number of characteristics usually recorded in surveys. Further research is needed to check on this and to determine what other characteristics should be recorded in an attempt to make such extrapolation possible.

Classification of disease. The *International Classification of Diseases* does not always distinguish between the various manifestations and degrees of severity of a particular disease although the care needed for each of these variants may be very different.

Use of 'indicator' conditions. It would be an enormous task to study the prevalence of every common abnormality in a study population, even if suitable measures were available for each one. Brotherston (9) suggested that unmet need over a wide front of medical care might be deduced from studies of the gap between need and utilization for a limited number of 'indicator' conditions. The extent to which some conditions are valid 'indicators' of general need has yet to be tested by research.

CLINICAL PROBLEMS

Determining facilities needed for treatment. This is a problem in two parts. First, there is a considerable variation in the treatment given for many conditions and therefore in the facilities required. The classical example is the marked variation in length of stay for elective surgical procedures. Secondly, there is uncertainty whether treatment is desirable at all in some circumstances, especially in the case of the borderline abnormalities commonly found in large numbers in surveys. The programme of controlled trials of treatment needed to resolve these uncertainties is another subject, perhaps the most important in medical care research, and is discussed elsewhere in this book. But meanwhile the interpretation of prevalence figures presents a difficult problem to the planner. The use of panels of experts to obtain a consensus of professional opinion might prove an advance on planning on the basis of local custom.

The adequacy of treatment received. A person included in a survey may already be a patient. In interpreting the findings of the survey, it cannot be assumed that any care which he is receiving is necessarily adequate and appropriate. This point would have to be checked before the findings could be really relied on in planning. Prescribed treatment may not have been accepted, or it may have been inappropriate or ineffective in the particular individual. Clinical case reviews for each patient discovered during a survey would meet this difficulty

but they would be elaborate and expensive and might raise difficulties in the relationship between the researchers and the patient's own doctors.

PLANNING PROBLEMS

Planning for the real world. The findings of either panels of experts or clinical trials will always be interpreted by different doctors in different ways. Even with effective health education, based on research into the factors determining demand, some individuals will go on using the NHS unwisely or not at all. Once everything possible has been done to encourage staff to use methods of care which are efficient as well as effective, and to teach people to ask for care when they really need it, the planner will still have to allow a margin to accommodate the reasonable variations in behaviour which will always occur in the real world.

Intuitive or sophisticated planning? The identification of any gross unmet need by a survey should improve health service planning whatever its techniques and mechanism. However, part of the challenge to the service is to develop the use of precise mathematical techniques in the analysis of survey and 'utilization' statistics in order to see whether it is possible to prepare plans which are more appropriate than when a less exact approach is used. The Department's Operational Research Unit is developing methods which should enable the consequences of alternative plans to be determined.

Can consistent priorities be devised and accepted? Doctors regularly and sometimes unconsciously attach different priorities to the needs of the different patients who consult them. Nevertheless, it is easy to acknowledge that the NHS as a whole does not always do the most important things first. Old people who put up with their illness rather than 'bother the doctor', or young people who are off work for an extended period waiting for an elective surgical procedure, certainly seem to be in greater need than some people who receive immediate attention. It is for this reason that it is now widely suggested that the medical profession should devise a system of priorities which could be accepted by all and which would be fairer and more efficient than the *de facto* rationing of services by waiting-list. There seems little point in carrying out comprehensive studies of need unless there is

to be both the public and the professional will to devise and adhere to such a system. Otherwise much of the need revealed by such studies, although recognized, will remain unmet.

CONCLUSION

It is essential to tackle the really difficult problems if the full promise of research as an aid to health service planning is to be realized. An effective means of measuring and planning for the total need for care is clearly a prize worth struggling for. Although important advances have been made, the study of need remains a subject which bristles with difficulties and it is still too early to say whether the ultimate objective of basing all plans on accurate measures of need can be met. Many lesser but still important objectives of this research are certainly attainable. Studies are clearly practicable and useful when they are limited to specific topics, especially in circumstances where there may be great need, in groups such as the elderly, or where the need is for something as comparatively simple as a hearing aid. The recent report on the Home Help Service (10) is an example of practical work which is certainly useful for planning. Indeed it could be that the more elaborate local studies will find one of their greatest uses by identifying topics in which country-wide studies would be fruitful. Studies of need can at the same time provide evidence on the cause of disease and can identify suitable populations for treatment trials, especially for trials of secondary prevention. This research is inevitably slow to yield results because many of the problems involved have to be solved sequentially and it is for this reason that a relatively limited programme of research remains appropriate. It will still be some time before the place of studies of need in health service planning can finally be judged and an extended programme of the kind described has to be reviewed regularly to check that reasonable progress is made. The progress made so far encourages the hope that practical solutions can be found for the difficulties which have been outlined.

Development and evaluation of new ways of providing health services

INTRODUCTION

The second challenge to the NHS discussed in this essay is to consider alternative ways of providing services, to develop promising

ideas on a trial basis and to subject them to scientifically sound evaluation. The inheritance of the NHS in terms of buildings has determined, to a considerable extent, the way in which it has operated until now but the development of a substantial building programme will allow the examination of a much greater range of options, provided that valid and practicable ways of testing them can be devised.

There is very little experience to go on. It is now widely accepted that planners and managers in any field of work should check whether planned goals have been reached and planned methods used, but very little evaluation of this kind has been undertaken in the NHS owing, no doubt, to the complexities of its work and uncertainties due to biological variation. Specific methods of treating individual diseases, particularly with drugs, are, of course, regularly evaluated. There are also examples to show that for such a simple service as a programme of immunization useful evaluation can be carried out, usually on the basis of routine statistics (11). However, the evaluation of a complex service is a vastly more difficult task and only recently has a research project been launched in which a scientific worker is undertaking this task.

Methods have to be developed for this work and this discussion is presented partly in the hope that public debate on the subject will turn from exhortation to a discussion of how best to carry out this form of research. In the next few pages we will consider some of the possibilities and will concentrate in particular on the suggestion that the technique of the controlled trial can be adapted and developed, using sociological and economic as well as clinical measures, so as to play at least a part in the evaluation of complex services.

Controlled trials of medical treatments with random allocation of subjects to experimental and control groups were accepted into clinical research at about the same time as the NHS was launched (12). There is now extensive experience of their use. The advantage of the basic method is that it eliminates spurious results due to the characteristics of a particular group of people on whom a treatment is tried. Many variations of the method have been developed, notably the 'double blind' technique, which is desgned to eliminate bias due to the expectations of both researchers and subjects. Although the dangers of departing from the scientific rigour of these methods has often been demonstrated, it seems fully justifiable to explore their use in

the many practical situations where trials cannot be carried out blind and other imperfections may have to be accepted, provided that the results are interpreted with great care. Their use in testing methods of patient management owes much to the advocacy and pioneering work of Professor A. L. Cochrane.

The argument will be developed as follows. An example will be given from Professor Holland's work of how controlled trials may be adapted to help the planning and development of relatively limited sectors of the NHS. Then, as an example of an experiment in new ways of providing health services, the Oxford Community Hospital Project, which Dr A. E. Bennett is to evaluate, will be described. Finally the theoretical difficulties of evaluation, the practical difficulties of linking research to practical health service planning and development, and the place of the controlled trial in evaluation will be discussed.

FRIMLEY AND BASINGSTOKE—EXTENDING THE USE OF THE CONTROLLED TRIAL

Professor W. W. Holland and his colleagues from St Thomas's are undertaking a series of trials of alternative methods in medical care at Frimley and Basingstoke, where new district general hospitals, one of them a so-called 'Best Buy' hospital, are being built. The aim is to identify and test solutions for the problems which will face the local health services in these areas when the hospitals open.

Preliminary studies have been undertaken of available health service and demographic statistics for one area (13) and of hospital referrals from general practice in the other (14). The trials are of alternative methods of management for specific clinical conditions but are so chosen that they will relate to and help to solve problems in organizing health services. They will take place only when it is agreed locally that it is an open question which of the alternatives is preferable, so that random allocation to one or the other form of care can be carried out ethically.

The Frimley studies. The studies which are being carried out at Frimley concern the clinical management of a number of specific medical conditions. So far four groups of conditions have been selected. The studies will test the value of early discharge schemes, hospital day-care, and the transfer of certain forms of care from

hospital to the community health services. Such changes in the balance of hospital and community care are commonly advocated and the hospital at Frimley has been built with an unusually low proportion of beds to technical facilities on the assumption that they will be put into effect there. The studies fall into the following groups. 1. Elective surgical procedures. Trials of the early discharge from hospital of patients treated for hernias or varicose veins have already started. Although the early discharge of patients with hernias has been studied before, this is the first time that random allocation of patients to the experimental and control groups has been used. The evaluation will be based on clinical outcome, on the attitudes of patients, their families, and the providers of care and on both direct and indirect economic costs. 2. Fractured neck of femur. A similar trial of early discharge is being considered. 3. Stroke. A case-register has been developed and the natural history of the condition is being studied. Trials of domiciliary physiotherapy and speech therapy are being considered. 4. Studies of ischaemic heart disease may follow.

The Basingstoke studies. The studies at Basingstoke are, in the first instance, concerned with whole specialties rather than with limited groups of conditions; and are likely to concentrate on testing particular, often relatively new, units of service rather than methods of patient management within existing units. Three groups of studies have been proposed. 1. Psychiatric care. A census of hospital in-patients is being followed by special clinical and social assessments, planned in co-operation with, and led by, the hospital staff. New methods to be put into trial may include the use of special community care housing. 2. Geriatric care. A study of utilization of the geriatric services by the community will be followed by trials comparing special housing for the elderly with local authority welfare homes on the one hand and domiciliary care on the other. 3. Acute in-patient medical care. It is hoped to study acute medical care given by GPs using beds in a general medical ward of the district general hospital. It is likely that indicator conditions will be selected for study in at least some of the three groups of trials.

Interpretation. Thus the hard core of the work at both Frimley and Basingstoke is a series of controlled trials of alternative ways of managing a limited number of conditions. The scientific evidence

which is obtained will apply with certainty only to the management of the particular conditions studied. The crucial point is whether these findings should be generalized and taken to apply to a wider range of conditions. In the case of the studies of methods of patient management of the type being undertaken at Frimley, it would be possible to introduce a new method, an early discharge scheme for example for one condition at a time, as each one is subjected to trial. (It might be more sensible and perfectly justifiable to make some general deductions from a single trial but it would not be necessary to do so.) In the case of the studies of units of service of the type being undertaken at Basingstoke, however, units have to be opened for use for a wide range of conditions or not at all and it may be necessary to generalize from the results of the studies based on the use of 'indicator' conditions. The Basingstoke studies thus bring one closer to the situation which is faced when complex services are evaluated.

THE OXFORD 'COMMUNITY HOSPITAL'—EVALUATION OF COMPLEX SERVICES

For some years the Department has encouraged the concentration of hospital services in district general hospitals in order that care of high quality may be given with efficiency. This policy has met with criticism on the grounds that not all patients need the costly technical facilities of a district general hospital, that a district general hospital can be difficult to reach from country districts and that GPs and patients alike value the small and friendly local hospital.

The Oxford Regional Hospital Board have concluded that, at least in their own substantially rural region, there is a strong case for GPs treating carefully defined types of patient in 'community hospitals', in accordance with policies worked out jointly by the GPs and their colleagues at the appropriate district general hospital. Under the scheme some 'community hospitals' would be attached to a district general hospital and others would be situated in small towns or rural areas. The arguments for and against this scheme are complex and it has been agreed that it should be carefully evaluated. Dr A. E. Bennett[1] has recently been appointed to devise and undertake the evaluation of an experimental 'community hospital' at

1. From the Department of the Regius Professor of Medicine (Professor W. R. S. Doll) at Oxford University.

present being built. It is hoped that evidence will be gained which will help to decide whether this idea should be adopted in other parts of the country.

Although it is evaluation which is being discussed here, Dr Bennett and his research team face an even more complex task (List no. 29). The pattern of work and management of the 'community hospital' cannot be fully determined in advance of practical experience and there are bound to be debates amongst those concerned on what is desirable and practicable. The research team will therefore be working during the development phase, gathering evidence to help to resolve these debates and to determine the nature of the 'community hospital' as it will be presented to the rest of the health service for consideration. Of course, development of such a service never ceases but at some point it will have to be defined and the evidence for and against its wider adoption presented. Dr Bennett will develop the details of his research strategy over a period of time. In the rest of this essay the difficulties of evaluating an innovation of this complexity will be discussed in general terms and one possible approach to the task of evaluation presented.

BASIC DIFFICULTIES IN EVALUATING COMPLEX SERVICES

In order to decide whether a new service is valuable and should be widely adopted, people need to know exactly what it is and what it does and whether there is good reason to think it better than any existing alternatives. There are three difficulties in providing the necessary evidence, which are particularly troublesome with complex services.

Timing the evaluation. A complex service cannot be held static while it is evaluated, as can the treatment of a single condition. It is unlikely that a proposed new service will be implemented all at once, exactly as originally envisaged, and if it is it will always be gradually adapted and improved.

The number of activities. In a complex service many activities concerning many different types of patient are carried out. It is clearly impossible to undertake separate controlled trials into each one of these and it is highly unlikely that results based on a few activities and a few conditions would be representative.

The nature of the comparison. Any new service is unlikely to be a direct replacement of another; the 'community hospital', for instance, aims to be a partial replacement for both the district general hospital and domiciliary practice, so that the real comparison is of two ways of providing a full range of services, one including the 'community hospital' and one without it. Besides further increasing the number of activities involved, this makes it very difficult to stage a comparison. It would obviously be impracticable to put both alternatives into operation in the same area, while contrasting alternative services placed in different areas could produce spurious results due for instance, to the different characteristics and experience of disease of the two populations.

AN APPROACH TO A SOLUTION

The solution may lie in isolating the questions which are most critical for judging the value of a new service, subjecting them to thorough scientific investigation, often by means of a controlled trial, and placing the results in the context of much more formal and explicit planning than is practicable as a routine within the NHS. The objectives and methods of any new service which was to be evaluated would be defined by those responsible for planning it. The criteria by which success in reaching the objectives would be judged would be agreed in advance. Much of the evaluation would inevitably be based on routinely available statistics and even on impression, but the key point of this approach would be that scientific research would be used to examine particular questions which had been identified as crucial to the cases of either the champions or the antagonists of the new service. Adequate answers could sometimes be obtained by descriptive research, particularly on such questions as access times to the place of care, but it is likely that controlled trials, using economic and social as well as clinical criteria, would occupy the key place in the research strategy. As answers were found to particular questions so the importance of others would often become apparent. It is an axiom of planning theory that planning and evaluation are continuous processes and it would be a matter of fine judgement to decide how far to go with an inevitably expensive research component in evaluation. In order that everyone could learn from experience with a new service, an evaluation would need to take place as

soon as the initial rapid development was over and a reasonably stable situation had been reached. If necessary a further review could be conducted at a later time.

Simulation. An important question is whether theoretical, mathematical, or even computer-operated, models of services can be developed to allow the functioning of complex services to be investigated theoretically before they are put into practice even as trials. There is reason to hope that they can, for it is difficult to obtain the co-operation necessary for testing a new service in practice, at least without many compromises and modifications. It should certainly be possible to assemble some of the elements of such a model from existing experience and perhaps from specially arranged isolated research projects, before starting on a field study, and to add to them from research undertaken during the early stages of implementation. Computer 'models' of a whole service, complex enough to allow a meaningful evaluation, are something which operational research scientists wish to develop, but it is far too early to know whether such 'models' are feasible or to look to them for help in evaluating new services.

PRACTICAL DIFFICULTIES IN USING RESEARCH FOR THE EVALUATION OF COMPLEX SERVICES

The use of research during health service development and evaluation raises practical difficulties which are best recognized and accepted in advance. A complex programme of applied research of the kind we have discussed makes demands on many people wherever it is carried out. For instance it may be necessary to keep special records; trials may involve working to a fixed plan; accommodation may have to be given up for an experimental use. It has to be remembered that clinical trials are usually undertaken only by those who are interested but that trials of a service need the co-operation of many who are uninterested or even antagonistic. Since research takes a considerable time to plan, implement, and analyse, and must be finished in time to be of use, it may become a crucial factor in the timing of the development of a new service. If evaluation is being undertaken in the way we have outlined, service plans and policies will have to be worked out in unusual detail; it is unlikely that sufficient numbers of experienced administrative staff will be readily available to undertake this.

Planning the research programme itself is therefore likely to be a cumbersome and time-consuming process. Because of the demands made on them the local health service staff must be involved in planning the research and the co-operation of all three branches of the service in this is likely to be necessary. The planning of research and service will have to be carefully co-ordinated and, at the same time, a clear understanding established of the respective roles of the research team, the various administrations, and the individuals in the service.

The ideal client for a research team would be an individual with well-defined power to facilitate research and implement the findings, who is committed to doing so because of the investment in the research which he himself has made. The NHS, with its tripartite administrative structure and widely diffused decision-making, presents a very different picture. Many people in the NHS welcome the aid of a research team with a well-established reputation and are often willing to give up their time for committee work and individual contributions but unless the local service as a whole can agree on a plan of work and act on it the research will be handicapped and may fail.

Experience even with simpler developments shows that it is difficult to attain this agreement and action. Although a joint planning committee is often set up to deal with a new development and to liaise with a research team, the statutory bodies concerned locally may feel unable to delegate effective power to this committee or to individuals working on it. Individuals or authorities may find it difficult to make the concessions necessary for a particular trial to proceed. One reason for this may be that some people may fear that an innovation launched on a trial basis may be accepted without full critical discussion. Proposals for a trial may therefore be discussed as cautiously as if they were proposals for a definitive service and even bodies not directly concerned locally may ask to join the discussions, so that they become unduly prolonged and the whole research approach is endangered. Another reason is that, because buildings must be given a definite size and shape and even services can be very difficult to change, the local health service staff may fear that they will have to live with an experiment ever afterwards, even if it has been judged a failure.

A research team may be responsible for many of the difficulties and misunderstandings which arise. They may have too little understanding of the realities of clinical and administrative work and be

too concerned with such matters as abstract problems concerned with research methods.

The team are likely to have their own internal problems. The work demands the co-operation of epidemiologists, clinicians, statisticians, social scientists, economists, operational researchers, data-processing experts, and perhaps others. The different disciplines tend to have their special terminology and communication between them can be difficult, while the provision of effective leadership in such a large, mixed team requires considerable tact and skill.

CONCLUSIONS

The development of effective methods for evaluating new ways of providing services would be of immense benefit to the NHS. It is probably naïve to suppose that scientific research alone will ever give conclusive answers in the evaluation of a new service or that work with computer models will ever entirely replace practical trials. But there is good reason to suppose that scientific methods can be developed to be of very great help. Difficulties, both theoretical and practical, are natural in the early stages of any type of research but we believe that the difficulties outlined here can be resolved. If our analysis of the situation is correct it will be necessary to pay for additional staff to service the planning activity in work of the kind described; there is obviously no fundamental difficulty here. The development of sound research and planning methods is bound to take time; there is no reason to doubt that it will occur. The most difficult thing which is required is the mutual understanding and co-operation of the researchers and of the many already busy people working in the NHS. There is bound to be a difficult period while methods are developed and results come slowly but if it is accepted that new ways of providing services should be judged so far as possible by scientific research then any concessions which are made to allow such research to be carried out should be rewarded by the progress which will result from it.

REFERENCES

1. TOWNSEND, P., and WEDDERBURN, D. (1965). *The Aged in the Welfare State* (Bell & Sons).
2. BUTTERFIELD, W.J.H. (1968). *Priorities in Medicine* (Nuffield Provincial Hospitals Trust).

3. LAST, J. M. (1963). 'The iceberg, "Completing the clinical picture" in general practice', *Lancet*, ii, 28.
4. HOLLAND, W.W. (ed.) (1970). *Data Handling in Epidemiology* (Oxford University Press).
5. ASHLEY, J.S.A., PASKER, P., and RECKITT, K.L. (unpublished). 'A pilot study on Canvey Island.'
6. ASHFORD, J.R., and PEARSON, N.G. (1970). 'Who uses the Health Service and why?', *Jl R. statist. Soc.* **133**, pt. 3, 295.
7. PALMER, J.W., KASAP, H.S., BENNETT, A.E., and HOLLAND, W.W. (1969). 'The use of hospitals by a defined population', *Br. J. prev. soc. Med.* **23**, 91.
8. BENNETT, A.E., GARRAD, J., and HALIL, T. (1970). 'Chronic disease and disability in the community: A prevalence study', *Br. med. J.* **3**, 762.
9. BROTHERSTON, J.H.F. (1962). 'Medical care investigation in the Health Service', in Davies, J.O.F., *et al.*, *Operational Research in the Health Service: a Symposium* (Oxford University Press for the Nuffield Provincial Hospitals Trust).
10. HUNT, A. (1970). *Government Social Survey. The Home Help Service in England and Wales* (HMSO).
11. GATHERER, A., and WARREN, M.D. (1971). *Management and the Health Service* (Pergamon Press).
12. MEDICAL RESEARCH COUNCIL (1948). 'Streptomycin treatment of pulmonary tubercolosis', *Br. med. J.* **2**, 769.
13. THORNE, S. (in preparation). 'Basic data collection and health service planning.'
14. CLARKE, M., and BENNETT, A.E. 'Problems in the measurement of hospital utilization' (in the press).

2. Screening in the early detection of disease

J. M. G. WILSON

An obviously attractive area of health services research is the examination of populations with the object of detecting chronic diseases at an early stage before symptoms have caused people to consult their doctors. The aim of such examinations, generally known as 'screening', is prevention in a double sense. It is theoretically possible, first, that a disease itself may be abated by treatment or advice given during the asymptomatic phase; and, second, that early treatment of a particular condition will prevent development of complications associated with middle and late stages of the disease. Clearly if diabetes or severe high blood pressure could be prevented, or arrested at an early stage, a large burden of ill-health could be avoided and redistribution, possibly even economy, of health services resources might result. Once clinical research has demonstrated the value of early detection and treatment there is an additional need for applied research into the implications for the provision of medical services; changes in the pattern of medical services required could result in concomitant changes in the distribution and use of resources. There is thus a strong case for the support by the central health department of clinical research in the field of screening for disease and its early treatment and this has formed an early and substantial part of R & D expenditure.

The questions of interest to the Department can be put quite succinctly: Whether? Who? How? At what cost?
The research programme will be described under these heads.

Whether?

Probably the most important question, because the most inclusive of other questions, is that of the validity of screening procedures.[1] What tests are available for the early, often presymptomatic, detection of disease and how valid are they? Does early treatment, compared with later treatment at the clinical stage, reverse or prevent progress of the disease process? These questions are fundamental, and unless the answers are positive, screening should not in theory be carried out as a service procedure. In practice these requirements cannot always be met before the decision to provide a service is taken.

The question 'whether' also embraces a number of subsidiary questions which need careful consideration before going on to the questions of 'how' and 'at what cost'. Many of these questions do not of themselves call for research but the answers may well determine whether a screening service should or should not be provided at a particular time. It is necessary to decide how important is the medical problem for which a screening service is proposed. Clearly, the answer will, to a considerable extent, depend on cost and the local economic situation. Are we justified, for instance, in setting up a special screening service for the very rare inborn errors of metabolism? One way of looking at this question is to consider the two factors of the severity of the consequences of the untreated condition and of its prevalence in the population. Another factor in determining the importance of a condition is the social attitude of people to disease; when this becomes highly developed people are ready to give a high priority to providing the resources needed for screening, in comparison with other 'necessities of life'. Another important question to be answered is the availability of the ordinary medical resources needed to deal with the diagnostic and treatment consequences of screening. We shall see below that to some extent this depends on how valid a test is used, but obviously there are situations (and these might arise in this country in the future) in which an unacceptable proportion of the normal medical services could become diverted into dealing with the investigation and treatment of large numbers of people (including those with positive screening tests but

1. Screening has been defined (1) as 'medical investigation which does not arise from a patient's request for advice for specific complaints'.

in fact without disease, 'false positive' responders) resulting from the institution of a screening service.

A further question under the heading of 'whether' is that of the acceptability of the screening test to those people at most risk of the disease. This was a problem for mass radiography and is now a problem of cervical cytology.

CERVICAL CYTOLOGY

The hope of reducing the incidence and mortality of cancer of the cervix, or even of preventing it altogether by cervical cytology screening, provides an example of this dilemma. Cervical cytological screening was well established in the USA and Canada (as well as in other Commonwealth countries) in the 1950s, at a time when it was not practised generally in the United Kingdom. Both professional and public pressure for a screening service grew. The weight of informal evidence, taken together with the general introduction of cervical cytology elsewhere, was such that the Department's advisers considered providing a cytology service an ethical obligation, and that the evidence of validity of the technique would have to be given the benefit of any doubt. At the same time two major research projects were commissioned by the Department (List no. 22). The aims of these trials are: to discover the validity of the cervical smear test; to learn more about the natural history of the supposedly pre-invasive state of *carcinoma-in-situ* by determining the effect of as total screening as possible in a female population on the incidence and mortality from invasive cancer of the cervix; to provide evidence on the optimal frequency at which the test should be performed. In the first trial there has been as total provision as possible of cervical cytology for a circumscribed population; in the second cytology has been provided on a large scale for an uncircumscribed population in a fairly scattered area. In this project individual women enter the trial when they are first examined cytologically, through registration of their names, age, marital status, parity, and social class. The prevalence and incidence of pre-invasive and clinical carcinoma of the cervix in the screened population can thus be compared for these factors with the experience of women in the country as a whole over the same time. Such studies are admittedly less satisfactory than randomized controlled clinical trials in which a control group of women would remain unscreened. But such trials should have taken place ten or

more years earlier when they would have been generally regarded as ethical. This illustrates an important point—the need to identify health problems and institute research well in advance of likely service demands; and therefore the need for a research intelligence framework. An attempt is now in progress to obtain better evidence of the validity of cervical cytology through a retrospective study of existing data in Canada, the USA, and Great Britain. This is an international collaborative study, the British part of which has been sponsored by the Department's Research Branch. It is hoped that a better understanding of the relationship between dysplasias, *carcinoma-in-situ*, and invasive cancer of the cervix, and of the effect of screening on the incidence and mortality of cervical cancer, will emerge as a result of this research. Some further examples from screening illustrate the importance of validation at somewhat differing stages of service demand.

DIABETES MELLITUS

The Department is supporting research into the value of the detection of early diabetes mellitus or of a possible pre-diabetic stage (List no. 57). This work follows the now classic procedure of identifying people at particular risk by means of a reproducible screening test (measurement of the blood sugar level under standard conditions) and then of randomizing those with blood sugar above normal but not reaching the level defined as abnormal, i.e. diabetic, into a treated trial group and a control group both of which are followed and compared for signs of developing disease. Intervention consists of randomizing diet and drug control by tolbutamide or phenformin. There is by now some evidence that the group treated with tolbutamide develop some 30 per cent fewer 'arterial events' over a period of six years than the control group. Though glucose tolerance may remain unaffected (2) the 'random blood sugar' may be lowered (3).

CHRONIC SIMPLE GLAUCOMA

Glaucoma accounts for some 12 per cent of the registered causes of blindness, of which an uncertain proportion consists of cases of chronic simple glaucoma (CSG) which runs a long and insidious course over many years before resulting in blindness. There is thus the possibility of early detection and the arrest of progress by treatment which is principally aimed at reducing an abnormally high

intraocular tension (IOT). For many years examining people in middle and later life for raised IOT, followed by definitive diagnostic tests for visual field loss and cupping of the optic disc, has been an accepted practice in a number of economically advanced countries. People diagnosed as having CSG are put on daily treatment for an indefinitely long period with drugs aimed at lowering IOT. Two recent studies have been carried out, one by an MRC unit with some support from the Department, the other by a university department with full support from a departmental research grant (List no. 60). The results throw doubt on some of the previously held views about CSG. Although there is, of course, no question that a high IOT is one of the usual triad of diagnostic signs in CSG, a prevalence survey of a population in South Wales showed approximately half the cases discovered did not have a raised IOT (4). Thus the usual screening method of identifying people with a high IOT by means of tonometry discovered only half the actual number of unknown cases of CSG in the population. In addition tonometry found that 6 per cent of the population examined (people of 40–74 years old) had a 'high' IOT (i.e. over 21 mm Hg) but CSG was not confirmed after further tests. This means that were tonometry to find general use in detecting early CSG in England and Wales and were, theoretically, all people over the age of 40 to undergo examination, with the present number of ophthalmologists each would need to examine some 4,500 people (5) among whom only 2 per cent would actually have glaucoma. This load of work would represent a very considerable debit cost in the use of services, particularly as examinations would need to be repeated at intervals—how frequently we do not know. Two other facts of interest in deciding about screening by tonometry have emerged from this work. First, follow-up of people with a raised IOT found during screening has not so far shown that these people are at greater risk of CSG than the rest of the population; what has emerged is that IOT is variable and may sometimes be raised but tends to revert to normal over the years (Perkins, personal communication). Secondly, there is some evidence that people with raised IOT who have been put on miotic drugs find it difficult to maintain the treatment and prevention may fail because of this operational problem (accepting that reduction of a raised IOT prevents the development of CSG which has not so far been demonstrated). This work has shown that a screening programme makes little sense in the absence of *(a)* a test which is

reasonably reliable in that neither too many false positives are identified, nor people missed who should be identified; *(b)* treatment which prevents the early or asymptomatic phase from developing into true CSG; and *(c)* good data on the natural history of the disease.

ASYMPTOMATIC BACTERIURIA

The work on asymptomatic bacteriuria (List no. 34) is an example of research into the incidence and natural history of a condition without symptoms, treatment of which may reduce sickness and suffering.

Asymptomatic bacteriuria is found in adult life, commonly in pregnancy (6), when symptomatic infections often supervene. Radiological examination in pregnant women with bacteriuria frequently reveals underlying renal abnormality, of which a proportion is attributable to chronic pyelonephritis—50 per cent and 5 per cent respectively, in Kincaid-Smith's series (7, 8). There is no good evidence that the progress of pyelonephritic disease can be influenced in adult life and for this reason interest in the detection of asymptomatic urinary infection is logically turning towards infancy and early childhood (9). There is evidence that infections starting in early childhood—particularly in the female—lead to progressive renal damage (10) and thence possibly to ultimate kidney failure. There is thus the hope that prompt detection and treatment of infection of the urine at its earliest stage (if study of the natural history of the condition confirms this hypothesis) may render less necessary the provision of the heroic (and costly) measures of intermittent haemodialysis and renal transplant surgery as well as the continuing burden for the patient and the profession of treating recurrent clinical urinary infection.

The prevalence of bacteriuria in schoolgirls is about 1 per cent and the conditions of school are favourable for the collection of urine specimens under sterile conditions from whole populations of girls (asymptomatic bacterial infection is much less frequent in boys—only 0·04 per cent). The Department is financing a project in Newcastle to determine the prevalence of asymptomatic urinary infection in the school population. Children with confirmed bacteriuria are referred for full diagnostic investigation and those with underlying renal conditions and/or pyuria are placed on treatment. However the significance of bacteriuria alone, without an underlying renal condition or pyuria, is not as yet understood. Children with asymptomatic bacteriuria alone, therefore, are randomly allocated to either a

treatment or control group. Both groups are carefully followed for signs of the development of pathology in terms of pyuria, renal function, and a rise in the level of antibodies to the infecting organism. In this way it is hoped to determine the need for, and feasibility of, screening schoolchildren routinely. It is intended to investigate preschool children in a similar way. Clearly, providing routine urine screening for all schoolchildren (and perhaps also as many preschool children as can be reached through the child health services) would be a large and costly affair and, before this could be recommended by the Department as a general service, it is of the first importance to determine both the value and cost in resources of this technique.

Complementary to this research the MRC has formed a working party to study and advise on the optimum methods of screening children for urinary infection. Research initiated by this working party should thus provide important evidence on which screening tests are most reliable in any particular situation.

PHENYLKETONURIA

Yet another instance of seeking or rather confirming the answer 'yes' to the question 'whether', is to be found in the joint interest of the Department and the MRC in improving the evidence for the effectiveness of diet in preventing mental retardation in phenylketonuria. Screening the newborn for phenylketonuria (PKU) by the Guthrie test on blood obtained from a heel prick, instead of the urine test previously used, has been advocated comparatively recently by the Department on the advice of the MRC. It is clearly important to know how successful this large-scale operation will be. The principal criterion of success is, of course, the normal mental and psychological development of children as a result of a diet of low phenylalanine content. The Department is collaborating with the MRC in the registration and careful follow-up of as many new cases of PKU as possible. This registration project should enable us to keep the screening situation under close and continuing scrutiny, and to determine the actual effectiveness of dietary treatment in preventing mental handicap, as well as exposing possible weaknesses in the administration of the screening programme. This is yet another example of fruitful collaboration in health services research between the Department and the MRC.

Who?

We have given examples of research into the validation of screening in the attempt to answer the question 'whether' some particular form of screening should be provided as a service and, of the five examples taken, we have seen that only screening for cancer of the cervix and phenylketonuria are at present provided comprehensively by the NHS. The next question for answer is 'who?'—for whom should a screening service be provided and who uses it? In providing an answer to the first part of this question we need to consider what special group or groups in the population at risk should be offered a screening service. The answer depends on such factors as age, sex, social condition, and family history. For example, certain conditions, such as inborn errors of metabolism, are normally screened for in the neonatal period; others, like deafness and mental development, in childhood; and yet others in pregnancy, such as diabetes, toxaemia, and rhesus sensitivity. The second part of the question, 'Who uses the screening service?', is the other side of the coin—a service is offered but may not be used. A useful example is again that of cervical cytology and departmentally sponsored research has been directed towards this problem—how to ensure that as high a proportion as possible of women at the most risk of cancer of the cervix attend for cytological examination. In theory all women are at risk but in practice we know from studies of the epidemiology of cancer of the cervix that some women are at greater risk of developing the disease than others. Older women, women whose sexual life has started early or who have had many sex partners, and women in the lower socio-economic groups are at much greater risk than those without these attributes. The standardized mortality ratios for cancer of the cervix in England and Wales show a wide variation between the lowest figure of 14 to the highest of 240 (11). Unfortunately it is the very women who are at most risk of contracting cervical cancer who in general make the least use of preventive and other medical services, and who do not readily attend for cervical cytology examinations. We know that so far we have not been very successful in the aim of improving the response in this group; for instance, about half the women screened belong to the relatively low-risk group of those under 35 years of age while women at higher risk, older women of

lower economic and educational level, tend to stay away. Work carried out for the Department by Wakefield and his co-workers in Manchester (List no. 22) (12, 13, 14, 15) shows that health education designed for women at risk needs to take account of socio-economic and educational levels. Also different ways of providing cytology are wanted by women at risk, both access to their family doctors and to clinics. At the time the research was carried out, few GPs were aware of the importance of their position both in providing screening services and in the education of their patients to accept the offer of cytological examination. Further studies on the attitudes of GPs and of women to cytology have been carried out, the main findings of which have been to emphasize the gap so far between expectation and performance. Mainly the women at least risk have been examined (though it can be argued that educating younger women of middle and high socio-economic levels is an insurance for the future); and there was evidence of insufficient information about the tests being given to the women examined. Women were found still to fear cancer strongly, particularly those at the lower income and education levels; but 72 per cent thought cancer could usually or sometimes be cured. Again, a division was seen between the social and educational levels, 90 per cent in social class I believing this compared with only 53 per cent in social class V. Clearly great problems of communication and health education persist and there is a continuing need for research in this area.

How?

In trying to answer the question 'how' we need to consider a number of factors. Screening can be provided in different ways and the choice will depend on considerations such as the interaction with the existing medical services, cost, and the constraints of the screening process itself. Thus either single or multiple tests may be offered, depending on factors such as age, sex, and parity; screening may be provided through general practice, local health authorities, or other agencies, or through a combination of these. Record systems, more or less complicated according to whether screening needs to be repeated and one examination linked with another, have to be provided if more than existing records are required; the rate of screening needs to be integrated with the available relevant diagnostic and

treatment services and with available manpower resources; and the cost has to be estimated and met. One way of minimizing the use of manpower and the cost of screening is to automate as many processes as possible. Once again, because cervical cytology has formed the main screening service of recent origin, an example of an approach to the question 'how?' through departmentally sponsored research can be taken from this field. Work is being supported on the automated preparation of cytological specimens for microscopy and the machine examination of these specimens using a computerized pattern recognition technique (List no. E37). If successful a considerable saving might be made in the laboratory manpower needed to prepare and screen cytology specimens (not only vaginal but also from other sources). Other projects aimed at automating cytology have been supported by the Department in the past, but have been concluded because of unpromising results. This work was based on two hypotheses: one that the content of the enzyme 6-phosphogluconate-dehydrogenase in cervical cancer and *carcinoma-in-situ* cells was greater than that of normal cervical epithelial cells, and that this could be detected by a biochemical test; the other that malignant cells and their nuclei have a larger volume than normal cells and that a population of malignant cells could be demonstrated by means of the Coulter counter (developed for the purpose of blood counts). Papers on both these subjects have been published (16, 17).

Another research approach in reducing demands on manpower is at the level of the respondent to the cytology invitation, and this technique is also directed at improving the response from women at particularly high risk. Instead of an invitation to undergo a conventional cytological examination (when women are invited to attend their doctor or a clinic to have a vaginal specimen taken) women are sent a kit through the post (a plastic irrigation pipette) which they can use themselves, following simple written instructions, in the privacy of their own home and then post the specimen to the laboratory direct. This technique thus avoids a clinical examination and (while there are obvious advantages in screening by clinical examination) would, if successful, have the double advantage of saving medical manpower and reaching women who would not otherwise be examined. A project in progress is comparing the irrigation pipette with conventional cytology under controlled conditions (List no. 16). The project is linked to a sociological survey (List no. 104) which, in

addition to providing information on women's attitudes to cytology, to cancer, and to medical services generally, is aimed at collecting data on women who do not use the pipette or the conventional cytology service—information which would otherwise be missing.

At what cost?

The value of screening, as has been hinted at above, obviously needs to be seen in the light of its cost particularly in terms of manpower. Some equipment may indeed be costly, for example a pattern recognition computer or radiography equipment for screening cancer of the breast; but compared with continuing manpower requirements this cost is undoubtedly slight. The Department therefore has a strong interest in studies of cost-effectiveness of screening (as well as, of course, of other forms of medical care). Unfortunately, these studies, though badly needed, are hampered by relative ignorance so far of the medical effectiveness of screening compared with conventional diagnosis and treatment of the same condition. Apart from evaluating screening for discrete disease the practice of multiple screening has been gaining popularity among sections of the medical profession and the public. Up to the present this form of screening cannot be said to have proved its worth and must be regarded largely as an act of faith. An example of multiple screening in Britain is the clinic that was instituted for one or two weeks each year by the Rotherham Health Department (18). This clinic offered a number of tests, for example for vision, respiratory disease, heart disease, cancer of the breast and uterus, to members of the public. People with positive screening test results were referred to their family doctors. A study by the Department's Social Science Research Unit (19) estimated the full cost of the Rotherham multiphasic screening clinic to be prohibitively high for the relatively few ascertained benefits it conferred. This high cost was not immediately obvious because much of the work had been carried out by dedicated volunteers and the cost of investigation of people who had positive screening tests, but who on further clinical investigation turned out not to have the disease for which screening had been carried out, had not been allowed for. When full allowances were made, and assuming all adults at risk were screened (which, of course, in practice would not occur) the real cost of screening, it was estimated, would have used 70 per cent of the

Rotherham Health Department's annual budget for all normal services. Another economic study is at present in progress, based on a study of multiphasic screening in the London area (List no. 8). This is one of the very few randomized trials of multiple screening in progress, if not the only one, and aims to determine the over-all effect on health and use of health services of providing a number of screening tests for the population of two group general practices. There have been a number of studies in the USA (20) but none of these has been randomized and their direction is more towards the questions of use of services, cost, and frequency of examination, rather than the effect of multiple screening in the prevention of clinical disease. An obvious advantage of multiple screening is the convenience and economy of offering several examinations on the one occasion rather than asking people to go to the trouble of attending separately for different tests. There is a problem that the section of the population at risk differs for different conditions. The benefits of multiphasic screening are still far from clear and several years more follow-up of the London study will be needed before a full assessment of the worth of this project can be made.

To conclude, the Department is supporting a not inconsiderable volume of research into the possibilities of screening, recognizing that this approach to medical care provision is one that is likely to develop rapidly (and has indeed started to do so), and that now is the time to find through research the answer to the all-important question of its real value in particular disease conditions. Attention needs to be given not only to validating screening procedures and the value of early treatment, but also to the practical questions of how screening should be performed under service conditions, which are the population groups at most risk and how they can best be reached, the frequency of screening needed, the effect on other services and, not least, the cost in relation to the effectiveness of the screening technique. Interest in the cost-effectiveness of screening has increased greatly over the past few years and studies of the type undertaken by Pole (21) have begun to be made.

One form of multiple screening in particular has attracted a good deal of attention in the Department's research and development programme, partly on account of the intrinsic interest in its potential for screening populations, but also because of its implications for the organization of medical care. This is the new development of

automation in the laboratory, both automation in the performance of a wide range of laboratory tests and automation in the monitoring, measuring, and handling by a computer of the laboratory results. The next essay deals with some of the developments in laboratory automation which the Department supports from central funds.

REFERENCES

1. MACKEOWN, T. (ed.) (1968). *Screening in Medical Care*, pp. 5, 8 (Oxford University Press for the Nuffield Provincial Hospitals Trust).
2. KEEN, H., JARRETT R.J., CHLOUVERAKIS, C., and BOYNS, D.R. (1968). *Postgrad. med. J.* **44**, 960.
3. —— —— (1970). *Atherosclerosis: Proceedings of the Second International Symposium*, p. 435 (New York, Heidelberg, Berlin: Springer-Verlag).
4. COCHRANE, A.L., GRAHAM, P., and WALLACE, J. (1968). *Screening in Medical Care* (Oxford University Press for the Nuffield Provincial Hospitals Trust).
5. PERKINS, E.S. (1965). *Br. med. J.* **1**, 417.
6. KASS, E.H. (ed.) (1965). *Progress in Pyelonephritis* (Philadelphia: F.A. Davis Co.).
7. KINCAID-SMITH, P. (1965*a*). *Lancet*, **i**, 395.
8. —— (1965*b*). In *Progress in Pyelonephritis*, p. 11 (Philadelphia: F.A. Davis Co.).
9. KUNIN, C.M. (1969). *Milbank meml Fund q.* **47**, 15.
10. SMELLIE, J.M. (1967). *Jl R. Coll. Phys. Lond.* **1**, 189.
11. REGISTRAR-GENERAL (1957). *Registrar-General's Decennial Supplement for England and Wales*, 1951. *Occupational mortality*, part II, vol. 2, tables (HMSO).
12. SANSOM, C. D., WAKEFIELD, J., and YULE, R. (1970). *Med. Offr*, **123**, 357.
13. WAKEFIELD, J., and BARIC, L. (1965). *Br. J. prev. soc. Med.* **19**, 151.
14. —— and SANSOM C.D. (1966). *Med. Offr*, **116**, 145.
15. —— —— (1968). Ibid. **119**, 193.
16. BOYD, J.T., GIBBS, D.F., LUBRUM, A.H., and PHILPS, F.R. (1967). *Br. med. J.* **2**, 785.
17. CAMERON, C.B., and HUSAIN, O.A.N. (1965). Ibid. **1**, 1529.
18. DONALDSON. R.F. (1965). *Br. med. J.* **2**, 1034.
19. DEPARTMENT OF HEALTH AND SOCIAL SECURITY (1969). *The Multiple Health Screening Clinic, Rotherham, 1966: A Social and Economic Assessment.* A report prepared by the Social Science Research Unit (London: HMSO).
20. COLLEN, M.F. (1967). *Methods of Information in Medicine*, **6**, 8.
21. POLE, J.D. (1968). In *Screening in Medical Care*, p. 141.

3. Laboratory automation

J. M. G. WILSON

Nowhere in medicine has there been more rapid growth in recent times than in the pathology laboratory. Past (at least in highly developed countries) are the days when the 'clinical pathologist' performed all his functions as the handmaiden of medicine in a little corner of the hospital, secluded from colleagues. Pathology services are now recognized as consisting of the specialist elements of chemical pathology (sometimes known as clinical biochemistry or clinical chemistry), haematology, microbiology (including virology), and morbid anatomy. The expansion of chemical pathology has been particularly remarkable, and it is with this, and haematology, that centrally sponsored research has so far been mainly concerned.

The number of tests performed in biochemistry laboratories has roughly doubled every five years over the past twenty years, sixteen to twenty tests accounting for most of the increase. Additional work in the laboratory has stemmed from increased demands for established tests and the introduction of new tests. The effects on patient care of increases in both the number and type of tests are obvious in some areas of laboratory work. However, in other areas we are virtually ignorant of their effect on the efficiency and effectiveness of clinical practice. For example, technological developments have made it relatively easy to perform a group of analyses on one specimen rather than single analysis on separate occasions from a patient. The question of the value of such techniques in patient care is of fundamental importance. In principle it is a question to which clinicians and laboratory workers jointly need to put their minds as the advent

of automation makes the provision of tests both easy and cheap. Apart from this the rapid development of techniques to meet this increasing demand has posed a number of practical problems which departmentally sponsored research is trying to solve. Most of this discussion will be confined to developments in chemical pathology, for that is where the greatest strides in advanced automated techniques have so far been taken. However, similar considerations apply to haematology, microbiology, and, to a lesser extent so far, to morbid anatomy.

The outstanding technical advance in biochemical technique for many years is probably the development of continuous flow analysis which has made automation practicable. It is now possible to carry out simultaneously large numbers of biochemical tests on a series of individual specimens of blood and other body fluids at a very rapid rate. One piece of current equipment, for example, will carry out twelve analyses on sixty specimens (720 tests) every hour; and equipment to deal with many more tests on many more specimens, at much faster rates, has already been developed. At once a data-handling problem is created and to meet this computers (small or large or both in conjunction) have been harnessed, not only for process control in such machines but also to deal with the mass of data produced by the analytical equipment. The data-handling problems consist mainly of receiving and identifying patients' specimens, reading and recording test results signalled by metering devices of many kinds, reporting and transmitting the laboratory results, and analysing the bulk data in terms of quality control which leads to the establishment of more valid 'normal' values than has hitherto been possible.

To make the best use of these advances within the NHS in the coming years, the Department formed two *ad hoc* advisory committees to supervise the various trials and innovations instituted to find answers to the main questions. These questions belong to two main areas; questions about equipment, its scope and performance in relation to cost; and questions about the application of approved equipment to health service situations.

The committee dealing with the first of these two types of question, the Laboratory Equipment and Methods Advisory Group (LEMAG) chaired by Professor I. Wootton, has been concerned not only with testing equipment and with the development of new equipment, but also with the problem of automated methods and the reproducibility

and accuracy of laboratory results. A scheme involving virtually all the NHS laboratories performing biochemical analyses, about 350 in all, has demonstrated that analysis of the same serum supplied to these individual laboratories produced a wide variation in results. The effect of laboratory size, method, and standardization of techniques on the quality of results is being studied.

Research in this field is supported through Supply Division's R & D Committee (the range of their research projects is published in Part III).

The other committee, the Laboratory Automation Trials Group (LATG) under the chairmanship of Dr J. P. Bull, has the job of exploring the role and organization of pathology laboratory automation in the organization and effectiveness of medical care. In addition to acting in an advisory capacity it recommends and reviews field trials aimed at answering outstanding questions. Broadly, the interests of the committee cover two areas:

1. The best organization and deployment of laboratory services, so as to provide as efficient and economical service as possible to hospitals and the community. Questions of interest are:

a. What population and patient services are best served by a laboratory equipped fully with automated analytical apparatus and a computerized data-handling system?

b. What automated facilities can be supplied for other hospitals, and what laboratory facilities need to be provided in most hospitals?

c. What are the staffing, transport, and other costing implications and how is the problem of the transmission of data best solved?

d. How do these questions affect the design of laboratories?

2. The use of laboratory automation in improving the standards of medical care. This aim has itself three aspects:

a. The study of the effect of automation in the laboratory on such factors as length of stay, the use of hospital facilities, and the need for admission to hospital as an out- or in-patient;

b. The use of automation in improving the clinical care of patients; in particular by taking advantage of the facility to provide a number of laboratory tests on blood or urine cheaply and quickly at the start

of a patient's investigation, to study the effect of screening compared with the provision of sequential discrete laboratory tests;

c. The improvement of comparability and accuracy of laboratory tests both in series and between series.

This form of screening (or 'profiling' as it is sometimes called) has so far been studied in hospital in- and out-patients and, to some extent, in patients attending their family doctor. The type of question these particular trials seek to answer is: 'will screening lead to a diagnosis being reached more quickly than by conventional means and, in addition, will it enable diagnoses to be made that would otherwise have been missed?' On the debit side answers are needed to the questions of the amount of additional investigation patients may be asked to undergo and the effect of inconclusive laboratory findings on patients, doctors, other staff, and hospital use. A logical further step is to examine the effect of providing a set of laboratory results on blood taken from groups of the public at special risk, for example infants, expectant mothers, and the elderly (the automated screening of blood from the newborn for phenylketonuria and other inborn errors of metabolism is already operating as a service). The Department's policy on screening has been discussed in another section of this account, but it is perhaps relevant to mention here that the approach to automated laboratory screening has been deliberately orientated firstly to the study of the hospital patient situation, then to the patient in general practice, and only thirdly to study of the possibilities for screening the general population, in the belief that this order of priorities is likely to be most productive of benefits to patients.

A progress report of the work of the LATG and LEMAG has recently been circulated by the Department to those concerned in circular HM(70)50 which lists the projects the Department is supporting.

Examples of trials in progress are:

1. Six small GEC-Elliott Automation Ltd 903 computers sponsored by the LATG to its own specification have been installed for trials in hospital laboratories; two with storage and updating capacity, the rest without updating capacity. Other computer trials use a small computer in the laboratory linked to a large hospital computer, or are concerned with the evaluation and costing of off-line systems.

2. Trials of laboratory screening of hospital and GPs' patients. These are based on studies at the Queen Elizabeth Hospital, Birmingham (List no. 1), and in nearby group general practices; and at Hammersmith Hospital (List no. 1001) and University College Hospital (List no. 1007) in London. The most advanced trials so far are in Birmingham and some of this work has already been reported (1, 2, 3). Findings of general importance to clinical medicine have been the clear demonstration of human operator bias in the performance of manual techniques compared with automated testing; and new information about the concept of 'normal' values for the blood biochemistry levels. The accumulation and computer analysis of a large number of estimations has shown, for example, that mean serum urea in a hospital population rises by age and is on average higher in males than females.

Screening hospital in-patients by providing a set of sixteen biochemical tests immediately after admission has demonstrated that a small number of important new diagnoses is made. There is, however, a high proportion of results classified 'abnormal' for which no immediate explanation can be found. These unexplained 'abnormal' laboratory results are attributable to failure to understand the variations in 'normal' values that are found with variation in age and sex, to laboratory error, to lack of understanding of biochemical changes in disease and occasionally to the detection of disease at a presymptomatic stage (4). Of the remaining 'profile' tests which the clinicians said they would not have requested about 1 per cent led to a new and unexpected diagnosis; while between 4 and 5 per cent of the tests were 'abnormal' but remained unexplained. In terms of patients (not tests, of which sixteen were performed for each patient) 8 per cent had 'profile' results leading to new or additional diagnoses, while in over one-third some 'abnormal' result was unexplained (after one year's follow-up this proportion was reduced to 15 per cent).

Of the 225 unexpected diagnoses, 72 were connected with an abnormal serum iron level (commonly, but not necessarily due to anaemia) and 33 for diabetes, based on the blood glucose. It is not possible to say how many of the cases of anaemia would have been diagnosed on routine determination of the haemoglobin, since haematology did not form part of the trial. One hundred and twenty other tests, in addition to those for diabetes and anaemia, led to a

Table 1. Analysis of clinician's questionnaire

Test	*Grand total*	NORMALLY REQUESTED *Total*	*Total normal*	NOT NORMALLY REQUESTED *Total*	*Total normal*	*Total expected*	Abnormal *Total diagnostic*	*Total unexplained*
Glucose	2,069	258	200	1,811	1,630	25	33	123
Creatinine	2,071	307	223	1,764	1,620	73	12	59
Urea	2,068	1,342	1,139	726	702	5	4	15
Sodium	2,070	1,336	1,253	734	703	3	0	28
Potassium	2,067	1,332	1,181	735	701	3	3	28
Total CO_2	1,054	119	89	935	869	16	4	46
Alk phosphatase	2,063	306	199	1,757	1,612	37	13	95
Bilirubin	2,068	237	177	1,831	1,722	18	9	82
$ZnSO_4$ turbidity	1,452	86	75	1,366	1,338	9	3	16
Albumin	2,064	535	409	1,529	1,485	17	7	20
Globulin	2,070	539	409	1,531	1,363	44	10	114
Calcium	2,069	242	170	1,827	1,660	30	15	122
SGOT	2,064	161	109	1,903	1,869	16	4	14
Iron	2,065	136	57	1,929	1,482	192	72	183
Uric acid	2,066	71	54	1,995	1,846	59	23	67
Cholesterol	2,059	229	182	1,830	1,705	29	13	83
Total	31,439	7,236	5,926	24,203	22,307	576	225	1,095
Totals as percentage of grand total		23·0	18·8	77·0	71·0	1·8	0·7	3·5
Tests normally requested as percentage of total			81·9					
Tests not normally requested as percentage of total					92·2	2·4	0·9	4·5

specific diagnosis. Some of the other unexpected diagnoses were: renal disease, malabsorption syndromes, hyperparathyroidism, Paget's disease of bone, multiple myeloma, gout, thyroid disorders, carcinomatosis, and chronic infection. Table 1, reproduced by kind permission from the paper by Carmalt (1), shows in terms of absolute numbers what the contribution of the 'profile' amounts to. In choosing the 'profile' tests to be carried out it was not, of course, known whether these were the tests most likely to give an important yield of abnormalities; the tests were those simply most frequently asked for by the clinicians in the medical and surgical wards concerned. After a short trial period serum chloride and carbon dioxide combining power were abandoned as providing too little information of value in the 'profile'.

In a general practice study Carmalt and his colleagues found 17 per cent of 300 patients with an unexpected diagnosis as a result of biochemical screening. Forty of these 50 patients had iron deficiency anaemia, 4 had renal disease, and 6 had diabetes mellitus. One patient had myxoedema. It is too early to assess the likely value of this form of screening; however, its main use seems to lie in finding

undiagnosed iron deficiency anaemia and diabetes. Elwood (5) has cast doubt on the clinical importance of relatively mild iron deficiency anaemia but some of the cases in the study of Carmalt and his colleagues had severe anaemia.

Randomized controlled trials are in progress in Birmingham, both in hospital in-patients and in general practice, to determine the effect of biochemical profiling on patient management. The in-patient study shows no significant difference in mean length of hospital stay between the 'profile' and control groups; some 'profile' patients undoubtedly stay longer in hospital as a result of the biochemical findings, while others probably have a shortened stay, thus equalizing the mean bed-stay with that of the control group.

The trials of Whitehead and his colleagues have been based on the Department of Biochemistry of the Queen Elizabeth Hospital, Birmingham. Recently with the generous help of the Wolfson Foundation in providing a building, the Department has arranged to support new research laboratories at the Queen Elizabeth Hospital (List no. 1) to be known as the Wolfson Research Laboratories. The general purpose of the Wolfson Research Laboratories is the advancement of NHS pathology services. In particular there are four principal fields of study: research; evaluation and trials of equipment; the development of new equipment (biomedical engineering); and training. The 'admission profile' work of Professor Whitehead and its extensions to out-patients and general practice are now supported as part of the activities of the Wolfson Research Laboratories.

All these studies are still at a relatively early stage and much remains to be learned about the implications of laboratory automation for clinical care and management as well as the effect on other hospital services (this last aspect is shortly to be the subject of special study by the Department's own operational research unit). In particular, we are still ignorant about cost and staffing implications and this is under current study. The actual cost of automated biochemical analysis is relatively low—sixteen tests can be carried out for about 75p per patient, the same as the cost of three tests performed conventionally. It may well be less costly to provide a set of tests routinely, perhaps in batches according to the needs of particular specialties, than to carry out fewer tests on demand.

Trials in biochemistry are so far the most advanced, but parallel work is proceeding in haematology and microbiology. We hope that,

with the help of all these studies, together with the results of work carried out elsewhere, it will be possible to make the best use of laboratory automation as the servant rather than the master of pathology services.

REFERENCES

1. CARMALT, M.H.B. (1969). In Williams, Roger (ed.), *Fifth Symposium on Advanced Medicine, held at the Royal College of Physicians*, pp. 268–78 (London: Pitman Medical).
2. —— FREEMAN, P., STEPHENS, A.J.H., and WHITEHEAD, T.P., (1970). *Br. med. J.* **1**, 620.
3. WHITEHEAD, T.P., and CARMALT, M.H.B. (1969). *Br. J. Hosp. Med.* **2**, Equipment Supplement 1, 49–51.
4. —— (in press). *Scientific Basis of Medicine, Annual Review 1971* (Athlone Press).
5. ELWOOD, P.C. (1969). *Proc. R. Soc. Med.* **62**, 495.

4. Nutrition surveys

W. T. C. BERRY

The object of the Department's nutrition surveys is to provide a scientific basis for national food policy. The problem as it appeared in the early 1960s was to build up a national picture of the state of nutrition, at least of physiologically vulnerable groups such as children, pregnant women, and the elderly. The expert body advising on the programme of surveys is the Committee on Medical Aspects of Food Policy (COMA) composed of eminent nutritionists, clinicians, and other scientists, together with officers of the health departments and the Ministry of Agriculture, Fisheries, and Food. The Chairman is the Chief Medical Officer.

The surveys were planned jointly by officers of the Department and nutritionists under the guidance of COMA. Supervision of the fieldwork was in the hands of departmental staff engaged for the purpose (and the fieldworkers themselves were recruited by certain local health authorities and by the Central Office of Information).

Nutrition surveys of the sort envisaged had not been carried out in this country since the advent of the computer and much preparatory work of a technical nature had to be done including the production of food tables and codes which were up to date and capable of providing information for analysis by computers with the minimum of hand-processing. These tables, based on information from many sources, were prepared in collaboration with colleagues from other departments and itemized over 800 foods for each of which the composition is given in terms of 13 proximal nutrients. The tables are too bulky and their potential market too small to justify publication, but

a limited number of copies are being lithographed for long loan to other investigators; several preliminary copies are in fact already in use outside the Department.

A start was made in 1963 with a pilot survey of preschool children. Investigators were trained, a nationally based sample drawn (from the Welfare Milk Registers), and negotiations completed with the local authorities of the areas concerned all of whom agreed that their medical staff should participate in the work. This help from doctors working locally either for the NHS or the local authority without reward save for the unique insight gained by them has been a feature also of the subsequent studies of pregnant women and of old people. The pilot survey (1) was made of 340 children. The next section describes briefly some of the problems which it revealed.

LESSONS OF THE PILOT SURVEY

Inaccessibility of areas surveyed. From the preschool pilot survey it was at once apparent that, from a sample drawn on a geographically national representative basis and studied in this way, information could not be obtained in sufficient detail to provide a basis for national food policy. Thirty-nine areas scattered over Britain had to be sampled and, though the dietary and socio-economic information was acquired by standardized procedures, clinical data was not so accessible and problems of inter- and intra-observer variation arose. It was impracticable to collect biochemical or other ancillary information on so scattered a sample but such information is essential to any estimate of the prevalence of malnutrition. The answer in the short term was to complement the surveys made on geographically representative samples, by 'depth studies' of a more detailed and circumscribed nature.

Non-response. Of 650 children initially contacted, only 67 per cent of the parents provided a satisfactory seven-day dietary record and only 79 per cent of these agreed that their child should have a clinical examination. There was evidence that among the non-participants there was an excess of children of mothers who were in employment and of children from large families—the groups about whose nutrition most concern was felt.

Processing of data. One problem which was at once encountered was the time-lag of one year or more between the close of fieldwork and the publication of results. A part of this is due to time being lost in the many consultations which sometimes have to occur in this field of work. A part is because most of the computer work has had to be undertaken by outside agencies. But a part arises from the volume of skilled and semiskilled man-hours necessary to 'clean' data and process it so as to yield a maximum of useful information. This is a manifestation of shortage of staff in a field where competition is keen and is a problem which has not been resolved. Though in one survey certain information was transferred to Cope-chat cards from the records as they were sent in, this information could not, of course, include an analysis of the nutrients consumed. Such delays may be acceptable under conditions of stability and prosperity; they might well not be so with rapid inflation or substantial changes in the price of food both relative to other costs and in respect of one food compared with another.

Despite problems of delay, geography, response rate, and the possibility that the groups most at risk might be missing from the participants, enough information emerged to justify this type of survey pending the development of other approaches, whilst accepting that it would be necessary in certain instances to complement such surveys by means of special 'depth' studies of issues which had been inadequately covered. The next section describes the development of an alternative approach.

DEPTH SURVEYS

For one section of the population it was recognized from the start that a geographically randomized sampling technique was impracticable. Surveys of the elderly require from interviewers special qualities of tact, sympathy, and insight. In addition the medical, biochemical, anthropometric, and other studies that have to be made are such that concentration and circumscription of the sample(s) are essential. Samples of the elderly were therefore surveyed in six areas of Scotland and England, which included north and south, urban and rural, coastal and inland localities. This approach was obviously born of necessity but it had virtue also as will be seen below.

The survey was of old people not living in institutions. From the analysis, though this is not yet complete, certain points emerge that

are of relevance to the problem of building up a national picture of nutrition. The first is that as a cause of differences in diet, geographical location was of less importance than social and, to a lesser degree, economic circumstance and the extent to which the old person was affected by non-nutritional disease. The second was that because the samples were circumscribed information could be obtained about the non-responders. This yielded indirect but useful evidence that in this instance the 'worst' cases were no more common among the non-participants than among those surveyed.

Though this survey had its defects of ragged sampling and uncorrectable variations between clinicians and between different laboratories in biochemical analyses (we were unable at that time to centralize all laboratory work), it was much more successful than the pilot 'breadth survey' of preschool children and far more of scientific interest and of value for food policy emerged. It posed the question of whether it was necessary to continue to conduct surveys based on geographical considerations. The answer obviously depends on what can be provided instead. There are various possibilities. In the case of the elderly it was found that the factors most obviously determining nutritional intake were sex and age. Therefore one crude possibility is to rely on data on sex and age in order to extrapolate the findings of the survey in depth to the country as a whole or in different parts which it is wished to compare. Possible refinements are economic, such as the proportion of individuals receiving supplementary benefit, the proportion living alone (though this proved a less useful means than had been expected of revealing contrasts in food intake) and the differing proportions of old people in the various Registrar-General's social classifications.

In the case of schoolchildren, application of the results of 'depth surveys' could be considerably extended if it could be shown that the average stature of large groups is a valid indicator of their nutritional state, as then all that would be needed would be to obtain data on the distribution of heights and perhaps weights in any area or in the country as a whole in order to assess the nutritional position. Failing this it might be necessary to determine the numbers of children in different socio-economic situations and to relate to this analogous information from depth studies. Currently, one survey of secondary schoolchildren has been completed by the Kent County Education Authority in collaboration with the Department of Clinical

Epidemiology and Social Medicine, St Thomas's Hospital with some assistance from the Department, while another by the Department alone is under way. Whilst one of the objects will be to test the relationship between stature and diet, information is collected relating to diet in different socio-economic situations.

THE USE OF SURVEYS IN FOOD POLICY

Two other 'breadth' surveys have been completed using the methods tried out in the pilot study already mentioned: one on 435 pregnant women and one on about 1,200 preschool children. The former has now been analysed and reported upon. Some findings relevant to food policy are described below.

In all surveys thus far analysed there has been a social gradient of nutrient intake. This has not been shown to be related to any noteworthy prevalence of clinically demonstrable malnutrition, even among the elderly about whom concern is felt.[1] On the other hand, among preschool children there is a relationship between the consumption of nutrients, such as protein, and stature. A similar relationship exists between the birth-weight of children and the diet eaten by their mothers when pregnant. From other information it is predictable that a similar relationship exists in schoolchildren. But it is highly unlikely that any nutritional survey will provide proof of whether these relationships are causal. Proof will only be forthcoming if a feeding test with some specially nutritious food is made and meanwhile any prediction of the effects of major changes in food policy has to be hedged about with reservations as to possible effects on growth.

On more specific issues more definite answers are forthcoming though the findings of 'breadth' studies usually need to be complemented by specific investigations of a more intensive character. This was the case in a question put to the Panel on Child Nutrition (of the Committee on Medical Aspects of Food Policy) as to whether changes needed to be made in our system of fortification of certain foods with vitamin D to prevent rickets. This was shown to be unnecessary (2). The findings of the survey of the elderly, too, are expected to lead to a number of specific recommendations which it would be wrong here to anticipate.

1. The survey was made in 1967–9. There have been rises in food prices since and though there has also been an increase in the value of the pension, there is no certainty that what was then found is still applicable.

THE USE OF RUNNING INDEXES

A nutrition survey reflects the situation at a single point in time. If by means of running indexes it can be established that in an ensuing period no important change occurs, or if the nature of the change can be accurately assessed, the need to repeat a survey becomes correspondingly less immediate, enabling resources to be concentrated upon other surveys or investigations. The nature and use of such running indexes was reported on by Berry and Hollingsworth (3). Of all the running indexes the most important at present is the National Food Survey which is the responsibility of the Ministry of Agriculture, Fisheries, and Food. Berry and Hollingsworth pointed out that partly because of a defect in the methodology of the National Food Survey, no running index has been evolved of the nutrition of the elderly. This question is being explored by the Department. The measures proposed include a follow-up of the 1967–9 survey subjects to test the prognostic significance of some of the signs found on the first occasion.

THE FUTURE

In the past the science of nutrition has been based on the laboratory, on the experimental animal and the human volunteer, and on intricate studies of a limited character. Now, if food policy is to be scientifically based, new disciplines, notably of epidemiology, sociology, and economics, will have to be learnt. The nutritionist will have to understand these new disciplines and in particular advance his science so that the simple tests that the epidemiologist needs to make on large numbers of people can satisfactorily be interpreted in terms of foods and nutrients.

The problem of applying to the nation as a whole the findings of intensive studies in depth has still to be resolved. If no satisfactory socio-economic indicators can be devised to replace 'breadth' studies of diet made on a geographically based representative sample, it is to be hoped that some shorter period of dietary study, perhaps only a '24-hour recall' as now used in the USA, will be found to be adequate. One of the reasons for non-response is the burden of keeping a record of the weight of all food eaten during seven days. Possibly some means will be found of linking studies in depth with the findings of national investigations such as the Family Expenditure or National Food Surveys and it is to be noted that COMA has secured that the

definitions of the groups surveyed shall be the same in all three sorts of survey thus facilitating the interpretation of one set of findings in terms of another.

There is no Institute of Nutrition in this country and the Department therefore has, in the past, undertaken nutrition surveys. Plans have now been made to transfer the work by stages to Professor Waterlow of the Department of Human Nutrition of the London School of Hygiene for an initial period of two years (List no. 17). There are perhaps risks as well as advantages in such a move. Survey work consists primarily of the collection of information relevant to the problems which the Department has to face while the prime interest of many university workers is research. On the other hand the studies can be seen to be under the aegis of a disinterested body, one moreover in which other relevant disciplines are strongly represented.

REFERENCES

1. MINISTRY OF HEALTH (1968). *A Pilot Survey of the Nutrition of Young Children in 1963*. Rep. Publ. Hlth and Med. Subj. no. 118 (HMSO).
2. DEPARTMENT OF HEALTH AND SOCIAL SECURITY (1969). *Annual Report of the Chief Medical Officer on the State of the Public Health*, p. 132 (HMSO).
3. BERRY, W.T.C., and HOLLINGSWORTH, DOROTHY F. (1963). 'The indices of nutritional change in Great Britain', *Proc. Nutr. Soc.* **22**, 48.

5. Mental health research

J. BROTHWOOD

Mental ill-health forms a large part of the general morbidity in all countries. In those where serious malnutrition and severe infections are no longer problems which the population as a whole need fear, attention is now being directed increasingly to the chronic diseases. This fact has particular importance for psychiatry where so much illness is chronic in nature. Besides increased medical interest on the part of both clinicians and epidemiologists, society's attitude towards chronic disease is changing. As the dangers of institutionalizing psychiatric patients have been described, so there has been a movement towards identifying the essential medical elements of hospital practice and separating these from the social, residential element which has become the statutory responsibility of the local authorities. These changes in public and professional opinion, which were embodied in the Mental Health Act of 1959, have profound implications for the organization of psychiatric services. It is generally agreed that far fewer hospital beds will be required for the treatment of mental illness in the future than is at present the case; but the transition from a system based on mental hospitals to one based on units in general hospitals, closely co-ordinated with social services, will take many years.

The scale of the problem may be judged by the fact that over 40 per cent of the hospital beds in England and Wales are filled by patients for whom consultant psychiatrists are clinically responsible. In general practice too, mental health problems are one of the commoner reasons for consultation, and there is also evidence from community surveys of a large pool of unreported mental ill-health.

The fact that the NHS exists and that it is comprehensive offers opportunities for research into questions which are not easily investigated in systems of health care where resources are fragmented or in which the ability of the individual to pay determines to a greater or lesser extent the care he receives. With a system of health care such as exists in this country it is possible to formulate as a long-term objective that those in greatest need should receive most help. For the mentally ill and mentally handicapped in whom the nature of the illness is often severe and prolonged, this objective offers the possibility of a greater share of resources than in the past provided that needs can be identified and effective therapeutic measures demonstrated.

Psychiatry is in the process of rejoining the main stream of medicine. Patients are no longer alienated, but are continuing to belong to the communities they come from. This process is not without problems. A modest start has been made in identifying some of the problems involved, and examples of the Department's contribution to the general research effort are given in the succeeding paragraphs.

The Department's research programme in psychiatry must be seen against the background of the considerable changes that have taken place in the development of services in recent years, and the special difficulties of definition and evaluation which arise from the relative absence of diagnostic criteria and measures of behaviour, based on objective physical signs or on the findings of biochemical or other non-psychological tests. Furthermore, the development of instruments for the measurement of mental and social functioning is often difficult and time-consuming, as is their application to individuals.

During the past decade the number of resident in-patients in mental illness hospitals has continued to decline, while the number of admissions and the numbers of out-patients and day-patients rise annually. There has also been a considerable expansion of the numbers of medical, nursing, and social workers in the service, and the number and types of personnel with whom a patient may have contact during a spell of treatment have increased greatly.

Special difficulties arise in research into psychiatric topics because of the relative lack of objective criteria for identifying mental illness as compared with physical illness. However, these problems can be and have been overcome by the creation of tests (e.g. questionnaires, tests of cognitive function) for specific purposes, whose reliability and validity can be determined. Naturally the less the deviation

from the normal, the greater is the difficulty in identifying behaviour as abnormal. These difficulties are perhaps most obvious in the field of general practice where it is generally accepted that psychiatric or psycho-social maladaptation is a frequent cause of consultation. For example, these disorders were found to rank second for females and fourth for males as causes of consultation in general practice in a study reported by Shepherd *et al.* in 1966 (1). Furthermore, it has been shown that only 5 per cent of patients with psychiatric disorders presenting to the GP services are referred to the hospital services and that those referred are not necessarily the most severely incapacitated. It is clear therefore, that the GP has a vital part to play in the diagnosis and treatment of persons suffering from a variety of mental disorders of varying severity.

In a series of studies Professor Michael Shepherd (List no. 18) and his colleagues at the Institute of Psychiatry have been elucidating some psychiatric problem areas relating to mental health in the community.

Since 1966 the Department has been supporting Professor Shepherd who has, *inter alia*, attempted to devise instruments for the measurement of psychiatric morbidity in the community as it presents to GPs. One such instrument, a self-administered questionnaire, was used to detect psychiatric disturbance in a series of consecutive attenders at a GP's surgery (2). When the results obtained with the questionnaire were checked against a standardized interview, it was found that the instrument had correctly classified over 90 per cent of patients as psychiatrically ill or well. The questionnaire also detected a small but significant fraction of individuals whose primary illness was subsequently identified to be psychiatric in nature, although the presenting complaint suggested physical disorder and was initially dealt with as such by the GP. The importance of the availability of a reliable and valid method of screening and measuring psychiatric morbidity in general practice cannot be overestimated both for the purposes of comparative epidemiological studies and for use by interested GPs. Such an instrument might also be of immediate practical use where a patient presents with a persistent physical symptom for which no organic cause is found.

Professor Shepherd and his co-workers have obtained much valuable information about the natural history of neurotic disorder (largely affective illness) treated in the setting of general practice. For

example, it has been demonstrated that while many patients with such illnesses recover quickly there is a surprisingly large group with chronic psychiatric disease. Further studies of the characteristics of this group have been made and the effect of an active intervention programme using a social worker is being studied.

Traditionally, medical and psychiatric social workers have tended to work from a hospital or hospitals as a base, thus adopting the same pattern of organization as the hospital specialist. More recently interest has developed in the possibility of attaching social workers to general practices and the results of the small number of experimental schemes have been described and seem to be encouraging. It seems likely that such attachments will grow as the Local Authority Social Services Act, 1970, is implemented. The work of Shepherd's group is highly relevant to this issue as they have examined and reported upon the relations of a group of GPs in a London borough with existing social work services and on their attitudes to collaboration with social workers (3). The results indicate that few doctors in the study had regular or frequent contact with existing social services and that the majority did not feel any need for such contact.

Such findings give impetus and urgency to recommendations such as those of the Royal Commission on Medical Education that the teaching of psychiatry and the behavioural sciences should receive more attention in undergraduate medical curricula than they do at present. Studies of the effectiveness of social workers attached to general practices are few but Shepherd's group is undertaking one such study at the present time which should throw light on this problem in due course. Another attachment scheme (List no. 1018) in Liverpool is being studied by Professor Alwyn Smith (List no. 22).

By contrast with psychiatric morbidity in general practice, a considerable amount of information has been collected and published over the years about hospital patients, especially psychiatric in-patients (Department of Health and Social Security Statistical Report Series). However, while in-patient psychiatric beds, their quantity, distribution, and usage, remain a central interest of the Department, the pattern of psychiatric care is altering. It is becoming more complex, with the use by some patients of a number of different facilities within a period of time. For example, a period of in-patient care may be preceded by out-patient care and subsequent day-hospital care or vice versa. Such a variety of contacts with services are not easy to

study unless a psychiatric case-register is established. The Department has sponsored the setting up of psychiatric case-registers in selected areas. In England, they are now established at Camberwell, Salford, and Nottingham. The advantages of such registers are that they record all contacts of persons living in a defined catchment area with psychiatric services over a period of time, thus making possible the calculation of prevalence and incidence rates and comparisons of usage between services; the existence of the registers enables changes in services to be monitored over time and permits description of the effects of the introduction of a new element to a service; and the register may be used as a sampling frame to select patients for controlled study of treatment. For example, one such study at Camberwell at the present time is concerned with the evaluation of the effects of intensive rehabilitation methods. Patients aged 18–54 with a diagnosis of psychosis who were reported to the register during 1968 were screened. Roughly one in four had been unemployed for one year or more, and from this group of unemployed, twenty-eight who were willing to participate and were thought suitable were allocated at random to a trial and a control group. Results are being assessed now and a report is expected soon (4). In November 1968 a conference sponsored by the Department of Health on psychiatric case-registers was held at the Maudsley Hospital and the papers have been reported in a departmental publication (5). Much of the pioneering work with registers has been undertaken by Professor John Wing, Director of the MRC Social Psychiatry Unit and by Dr Lorna Wing, a member of the MRC's External Scientific staff—part of the cost being met by the Department (Lists nos. 19 and 25). The Camberwell register may be said to have served as a prototype for register development elsewhere in England and there is no doubt that registers will prove a most useful instrument for describing existing services and changes in them over time, in a small number of specially selected areas (6, 7, 8).

The problems of mental handicap have been the object of much public discussion recently. The Department has been sponsoring basic epidemiological work into this problem since 1963. This work was undertaken by Dr Albert Kushlick in the Wessex Regional Hospital Board area and consisted of a census of all the mentally handicapped known to medical services in the area, performed at the end of 1963. Subsequently an ongoing case-register was established

using the census information as a base-line. The former gave valuable information about the geographical distribution of mental handicap in the region, its degree, and associated physical and behavioural abnormalities. From this information Kushlick constructed an estimate of the frequency of various types of handicap likely to be found in a given population of 100,000. In addition, over the years the register, based on the census of 1963, should give information which is lacking at the present time about the morbidity and mortality experience of the mentally handicapped. This information should be of considerable use in indicating the trends in medical and social handicaps, of the mentally handicapped.[1] Much of the data from the Wessex study has already been used in a departmental feasibility study of a development project for the mentally handicapped of Sheffield (List no. 1027). More recently, the MRC, the Department, and the Wessex Regional Hospital Board, in conjunction, have planned two hostels, one in Southampton and one in Portsmouth (List no. 1024) for mentally handicapped children. These are to be evaluated from the standpoints of the possibility of such units catering for mentally handicapped children with a wide variety of intellectual and physical handicap, of the type of staff required for this work, and the cost of such units, as compared with the more traditional type of care provided in a hospital setting.

As for the future it is difficult to predict in detail the content of the Department's likely research programme in mental health. However, without doubt there will be a considerable commitment to evaluate two major development schemes at present being planned by the Department in conjunction with the regional hospital boards and appropriate local authorities (Lists nos. 1026 and 1027). One is concerned with services for the mentally ill, the other with services for the mentally handicapped. At Worcester, the aim is to provide a comprehensive service for the mentally ill involving psychiatrists, nurses, GPs, and social workers, with the hospital element based on two units situated at general hospital sites (one at Worcester and the other at Kidderminster). The intention is to stop admissions and to ultimately close Powick Hospital which is at present responsible for providing the psychiatric service for this area. The new service will comprise fewer beds, considerably more day places, and an expanded

1. This work is also being financed until 1972 by a grant from the MRC to the Institute of Education.

mental health social service as compared with the old. Evaluation will largely consist of a comparison of the before and after situation. As the new buildings will not be available before mid 1974, time exists for an adequate assessment in depth of the quantity and quality of the service at present being given. After the new buildings have come into use and once the new pattern of service is established, further comparable studies will be performed. It is expected that quantitative changes in the use of services will be estimated by means of a case-register. Special techniques will be used in evaluating the quality of the service and the implication of mental illness not only for the patient but his family. In addition due regard will be paid to assessing the cost of the service in terms of benefit and effectiveness.

Similar considerations apply to the scheme at Sheffield, the aim of which is to provide a modern service for the mentally handicapped. The emphasis on this scheme is on better multidisciplinary assessment for children and, where required, adults. Subsequent to assessment the emphasis will be on education and social care and it is expected that as a result the requirements for hospital beds will be less than at present.

Both these developments represent the bringing together of experience accumulated in many different parts of the country. Provision on this scale and with the particular mixture of component facilities has not been made before. The results of evaluative studies will be of the greatest importance in the development of future policy for the mental health services as each of these development studies is unique.

REFERENCES

1. SHEPHERD, M., COOPER, B., BROWN, A.C., and KALTON, G. (1966). *Psychiatric Illness in General Practice* (Oxford University Press).
2. GOLDBERG, D.P., and BLACKWELL, B. (1970). 'Psychiatric illness in general practice. A detailed study using a new method of case identification', *Br. med. J.* **2**, 439–43.
3. HARWIN, B. G., COOPER, B., EASTWOOD, M.R., and GOLDBERG, D.P. (1970). 'Prospects for social work in general practice', *Lancet*, **ii**, 559–61.
4. WING, J.K. (in press). 'Unemployment among chronic psychotic patients in Camberwell: their need for rehabilitation' (Paper given at the Royal Society of Medicine meeting 19 March 1970).
5. DEPARTMENT OF HEALTH AND SOCIAL SECURITY (1970). *Psychiatric Case Registers*, Wing, J.K., and Bransby, E.R. (eds.). Statistical Report Series no. 8 (HMSO).

6. WING, L., BRAMLEY, C., HAILEY, A., and WING, J.K. (1968). 'Camberwell Cumulative Psychiatric Case Register. Part I. Aims and methods', *Soc. Psychiat.* 3, no. 3, 116–23.

7. FRYERS, T., FREEMAN, H.L., and MOUNTNEY, G.H. (1970). 'A census of psychiatric patients in an urban community', ibid. 5, no. 4, 187–94.

8. HAILEY, A., WING, I., and WING, J.K. (1970). 'Camberwell Psychiatric Case Register. Part II. Basic data required for planning,' ibid. 5, no. 4, 195–202.

6. Research and general practice

T. S. EIMERL

Most episodes of illness are handled by GPs without reference to a hospital. Estimates of the volume of work treated wholly in this way range from as much as 90 per cent (1) to a lower level of about 75 per cent. Estimates of the number of times a year a GP will see one of his patients range from an average of five to more than eight for children and the elderly; by contrast the average number of attendances at hospital for each member of the population is just under one (1).

This is the pattern of medical care in this country today. In the first half of the last decade a crisis was reached that seemed likely to do away with general practice as we had known it, in the same way as had already happened in certain other countries. The resolution of this crisis led to a much more confident attitude in and towards general practice and to the belief that its essential features could be preserved in a form adapted to modern medical and social conditions. Much of the credit for this renaissance is attributable to the steadily increasing influence of the College of General Practitioners which was founded in 1952.

General practice records are often less comprehensive and detailed than those of hospitals but, in spite of the lack of knowledge about much that goes on there, plenty of evidence exists that an unspectacular process of adaptation has been taking place ever since the start of the NHS and that the pace has greatly quickened in recent years. The trend of change is well-known but the main indicators must be mentioned here because they are the background to the Department's approach to its research programme in general practice.

The percentage of doctors in groups and partnerships has been steadily growing:

Table 1. England and Wales. Proportions of principals in single-handed and in partnership practice, 1952–68 (percentage)

	Principals in the practice 1	2	3	4	5	6+	*Total*
1952	43·6	33·0	15·0	5·7	1·6	1·1	100
1959	31·2	35·7	19·5	9·3	3·3	2·0	100
1966	24·0	31.1	24·0	12·9	4·5	3·5	100
1968	22·6	27·3	25·4	14·4	6·1	4·2	100

The concept of the 'health team' is widely accepted; the number of attachments of local health authority staff continues to grow and roughly 70 per cent of the 10,000 practices in England and Wales now employ ancillary staff of their own. The increase in the number of health centres is gathering momentum. Home visiting has declined. Open access to hospital diagnostic facilities has greatly increased. Most important of all in the long run, serious attention is at last being given to training for general practice at both the undergraduate and postgraduate stage; the numbers of GP attendances at postgraduate courses provided through universities has grown from 4,304 in 1962/3 to some 33,000 in 1968/9: many GPs attend courses elsewhere.

Underlying these changes in organization were the social, industrial, and scientific changes which were producing at once a constant succession of new techniques for diagnosis and treatment and a profound alteration in the pattern of disease and the causes of death in this country. An increasing proportion of the illness with which the family doctor had to deal occurred in the latter part of life and was primarily degenerative in character; he was being increasingly faced with the social and psychological problems of his patients; and he was becoming more concerned with the prevention of disease.

Thus the picture of general practice that was emerging in the 1950s and early 1960s was one of continuity of essential function combined with a widespread re-examination of traditional methods. It was against this background that, under the stimulus of the Gillie report in 1963 on *The Field of Work of the Family Doctor* (2) and with the opportunities opened up by the rapid emergence of the Royal College of General Practitioners as a focus of research and education,

the Department began to plan and sponsor a substantial programme of general practice research.

It was apparent that there were two broadly distinct fields to be explored, the clinical/epidemiological and the operational/organizational. Underlying the prospects for each was the question of how the research could best be carried out and what part in it GPs themselves could most usefully play.

CLINICAL/EPIDEMIOLOGICAL RESEARCH

'Observations in general practice' had been firmly recognized as in the mainstream of medical research in the report in 1953 on *Clinical Research in Relation to the NHS* by a joint subcommittee of the MRC and the Ministry of Health; and subsequently the MRC appointed a Committee for Research in General Practice and the Ministry incorporated general practice in its scheme for locally organized research (see 223). In the same period the RCGP formed their research unit in Birmingham with the primary role of providing expert advice to GPs wishing to carry out research projects. Thus the essential arrangements for clinical/epidemiological research in general practice were already in existence and it seemed that the Department's main contribution to this part of the field should make use of established channels. A substantial grant-in-aid was therefore made to the RCGP's research unit and GPs were encouraged to extend their use of the scheme for locally organized research. The Department's further interest in this part of the field has concentrated on helping to improve the basic recording and information system which is the prerequisite of research, for example by assisting in the provision of age/sex registers—now regarded as a normal tool of practice management and maintained by clerical staff; and on initiating studies to define the GP's role in some of the increasingly important fields of work for which his training would least have prepared him, for example the studies of psychiatric illnesses in general practice reported on p. 79, or the study of domiciliary care in terminal illness (List no. 96).

OPERATIONAL/ORGANIZATIONAL RESEARCH

Most of the studies in general practice sponsored by the Department have deliberately been concerned with describing and evaluating the pattern of practice and the changes that were developing in it.

Examples that may be mentioned are the studies of the role of different members of the 'health team', for example the SRN, the health visitor, and the social worker in taking over from the doctor work previously carried out by him and in widening the range of services provided; studies of different patterns of group practice and practice premises; studies of communication between GPs and hospitals on referral and discharge of patients, and of communication between GPs and their patients; studies of transport of patients to the surgery by practice-controlled transport; improvements in practice records; and the development and testing of self-administered questionnaires by patients in advance of consultation.

It was clear that to meet the demands of modern medicine the GP would need not only changes in organization but even more a recast and more systematic form of postgraduate and continuing education, a need well emphasized in the report in 1968 of the Royal Commission on Medical Education. There were good reasons therefore for departmental support of the experiment begun in 1969 by the Department of General Practice in the University of Manchester (List no. 20).

Three different schemes of three-year post-registration training programmes have been set up in the Manchester Regional Hospital Board area. Other similar programmes in the Universities of Belfast and Newcastle and in the Ipswich Hospitals Group are being evaluated. In each programme two years are to be spent in four six-month SHO posts and one year in a training practice. Since formal programmes of this kind are only now being introduced an objective study of their usefulness is of interest and importance. The aims of the study are to discover whether vocational training should include formal organized education and if so where it is best placed in the programme. A second purpose is to develop and to test methods of evaluation. Each of the programmes in the seven areas will undergo the same evaluation. This will attempt to measure any detectable changes in knowledge, skills, and attitudes of those who pass through the different regimes.

ORGANIZATION OF RESEARCH

The earlier studies supported by the Department were modest in scope and showed the difficulties inherent in organizing long-term research in a field in which, with a few notable exceptions, there were

no recent traditions in the planning, execution, and evaluation of research. However, as academic and other professional research centres came increasingly to interest themselves in NHS problems, it became possible to incorporate the bulk of general practice research in these wider programmes. Research involving general practice, however, will only be successful with active collaboration by GPs themselves and the Department's policy has been to ensure that GPs were included in these multidisciplinary teams and were playing a full part while still remaining, as is equally important, actively concerned in providing medical care for patients. It will be seen from the list of current projects in Part III that work which includes general practice is now being undertaken in a number of university centres and that it is increasingly concerned, in anticipation of the unification of the health service, not with general practice or any other branch of the service in isolation but with the interrelationships and co-ordination which are the necessary prelude of full integration.

REFERENCES

1. *Digest of Health Statistics for England and Wales* (1969). Table 4·3 (London: HMSO).
2. *The Field of Work of the Family Doctor* (1963). Para. 26 (London: HMSO).

7. Research into nursing problems

H. MARJORIE SIMPSON

Nurses form the largest single group in the NHS work force. The 286,317 (244,461 whole time equivalents, WTE) nursing personnel in the hospital and local authority services represent a substantial commitment of manpower and financial resources (1). Yet still there is a shortage of nurses. The Annual Report of the Chief Medical Officer of the Department of Health and Social Security, 1969, says, 'The nursing profession is not alone in the problem of recruitment; nevertheless the needs of patients must continue to be met; either more men and women must be attracted to enter the profession or more must be persuaded to return to it. At the same time, the organization of patient care must be examined to see that trained man- and woman-power is used efficiently and effectively' (2).

Nurses are the group of health service personnel most directly and continuously in contact with patients and with the public. Inevitably the comfort of patients and the effectiveness of local authority health services depends in large measure on the effectiveness of the nursing service. Research can make a contribution to nursing service, practice, and education problems. It is important that such research should be continuously in progress and that well-established channels of communication exist to ensure that the end products of research are made swiftly available to the people who provide the service.

The use of research to examine nursing problems is not new. Florence Nightingale whom Sir Edward Cook calls a 'passionate statistician' based her reform of nursing on systematic inquiry and careful statistical analysis. Kopf says of her: 'Florence Nightingale

may well be assigned a position in the history of social statistics next to those occupied by Quetelet and Farr. Her ardent, genuine sympathy for the sick and distressed was greatly augmented by a positive genius for marshalling definite knowledge of the forces which make for disease and suffering. The same intellect which sharply separated the formulae, procedures and practical methods of nursing from its abiding principles as one of the humanities, also discerned the statistical facts of sickness and other forms of disharmony between the individual and his environment' (3).

Unfortunately the habit of investigation and research was not incorporated in the Nightingale tradition as it was handed on and today the development of a programme of research in nursing has to take account of the absence for nearly a century of systematic study of nursing practice and administration. Thus there is no foundation of established fact or developed background theory to use in meeting the changing demands of modern times. Nursing does not have that minority of research workers usually found in a profession and the profession is not research-minded.

The general policy in developing research has therefore been to seek to establish groups which will take a continuing interest in specific aspects of nursing. Such groups also provide training facilities for research workers, including graduate nurses. It is valuable if they are so located that there is a ready channel of communication to the profession.

Some teams have been set up to study problems specifically of importance to nursing. At the Royal College of Nursing (Rcn) there is a research team studying quality of nursing care. The subject is intrinsically important if modern nursing is to change in harmony with the changing demands for nursing skills in modern society. It has additional importance in that to date nursing studies have been of a descriptive nature, in many instances identifying factors which appear to influence unsatisfactory situations. The next step in the build-up of knowledge would clearly be to experiment with, and to evaluate, the suggested remedies. Where the intention has been to provide improved nursing care the studies are held up because ways of assessing nursing care are not available. Various approaches to assessment of quality of care have been and are being tried. The Rcn approach seeks to move on from the consensus of nursing opinion type of study, which has been extensively developed in the USA, to

identify, within the categories of activity judged in the American studies to be important, certain aspects of the work which might lend themselves to measurement. If the work is successful it will gradually build up a battery of tests, mainly identifying objectives and measuring achieved against intended results, which could effectively supplement the unstructured professional judgement which has up to now been used for assessments. Nursing practice and its evaluation are so clearly a responsibility of the profession that nurses are engaged on the studies. Some are graduates and some are not, but all receive training in research methods and work under the guidance of consultants from the appropriate specialties, statistics, sociology, and medicine.

The research team at the General Nursing Council has a multidisciplinary group looking at nursing education with specific reference to experimental courses. Experimental courses in nurse training have been in existence for many years but particularly with the recent growth of university courses, shortened courses, and combined training schemes, some objective look at what is being achieved is indicated. The unit was fully operational from January 1969. It has a useful policy of providing papers for publication as the work progresses. The first of these appeared in April 1970 on the identification of nurses with academic degrees in the existing nursing population (4).

Nursing problems also benefit from being studied in close association with work on other aspects of practice, service, or education in the NHS or in association with more general studies. At Brunel University hospital administration is being studied by a team looking at nursing, medical, and lay management. In addition studies of industrial management are in progress. In the Department of Preventive and Social Medicine, University of Manchester, graduate nurses have just begun to work on nursing problems in the public health field alongside workers from other disciplines examining other aspects of public health.

The Department sometimes finances single studies at the request of nursing organizations with particular problems requiring investigation. The Royal College of Midwives was the first such body to receive a grant from the Department. This was for a study of the availability and use of parent-craft classes published as *Preparation for Parenthood.* Grants have been made to the Queen's Institute of

District Nursing and to the Training Council for Health Visitors for studies relating to home nursing and health visitors.

Nursing problems are not unique and much research which is initiated and carried through primarily for reasons other than the examination of nursing problems has relevance for nurses. This, for example, is true of work in progress on the care of children in hospital, the use of plastic isolators, the development of health centres, the design of buildings and equipment and monitoring apparatus. Almost any study which relates to the way patients are cared for is likely to be of importance to the nurses concerned in providing such care. They may or may not be involved in the teams carrying out the investigations but the findings need to be made easily available for incorporation in practice.

Obviously it is important to train nurse research workers who can take a full part in the research teams, including, where appropriate, leadership roles. Some resources have therefore been devoted to financing in universities research fellowships for graduates, including graduate nurses. The hope is that a small corps of research workers will be built up, interested in and familiar with nursing problems.

Co-ordination of research and implementation of findings are important and difficult. The research groups referred to above will, it is hoped, become the nuclei for progressive growth of knowledge on specific aspects of nursing and information centres from which other research workers and practitioners in the field can obtain information. It would be expected that such centres would also develop new research techniques appropriate to their subjects.

It was said in Part I of this volume that 'the Department's programme is only a minor element in the total research effort in the medical and allied social sciences', and that 'any research programme is a compromise between need and opportunity'. The Department's research programme constitutes only a small part of the total work on subjects related to nursing. Within the programme lack of skilled research workers and lack of established research centres have handicapped development and opportunities have had to be taken as they occurred to further the investigation of nursing problems.

There remains, however, an obligation on any grant-giving body to attempt to use its funds to build up coherent research programmes. Much unco-ordinated research work is undertaken. There comes a time when a sufficient volume of work has been published to warrant

a review to see what has been demonstrated and where further research could profitably be stimulated. It may well be worth while to pay for this type of work. An example in the nursing field arose when some sixty to seventy studies of nurse recruitment, selection, and wastage had been reported. Mostly the studies were on a small scale but one or two larger fact-finding exercises had been carried out. A few of the studies were financed by the Department but most had been supported from other sources. A summary and assessment of these studies was commissioned by the Department. It was undertaken by Dr Jillian MacGuire and published as *Threshold to Nursing* (5). It has subsequently been the subject of a King's Fund Conference for the profession at the Hospital Centre with a further follow-up eighteen months later to see how far implementation of the findings had progressed. Meantime the opportunity is being sought to follow up some of the needs for further research highlighted by the survey.

A more satisfactory way to advance knowledge occurs when it is possible to use the findings of each project to progress to the next stage in the build-up. Then descriptive studies with identification of variables lead on to evaluated experiments which progress to field trials and so to a management tool or to findings which can be incorporated in practice. Studies of patients' opinions about the care they receive in hospital have followed something of this pattern. The studies have mainly not been government financed. Twice, however, the Department has joined in to finance projects essential to take the work a further stage. The first time funds were provided for an experiment (6) to test the efficacy of techniques recommended on the evidence of previous studies as likely to improve communication between staff and patients. The techniques proved ineffective but other work (7) suggested a new approach. Further experimental work on this new line has now been commissioned.

The Department may contribute to the development of work on a particular subject by undertaking studies within the Department. This is perhaps a fitting place to pay tribute to the Nuffield Provincial Hospitals Trust for initiating the early descriptive studies of nursing activities. *The Work of Nurses in Hospital Wards* (8) broke new ground and provided a classification of nursing tasks which has subsequently been widely used. Together with the work of Barr (9) in Oxford in developing a classification of patient dependency this early

work has provided the basis from which many nursing studies have developed. The use of nurses and the conservation of nursing skills for essentially nursing tasks have been the subject of a wide range of studies. The Department's O & M team has contributed extensively to the examination of nursing activities in all branches of hospital work. A Department team has completed a study of the deployment of nursing staff in acute hospitals. This study identified factors normally taken into account in the distribution of the nursing work force within hospitals. It separated them from factors applied by individual nurse administrators but not conforming to any identifiable general practice. For example, some hospitals have more staff, some the same number of staff, and others fewer staff in divided wards as opposed to undivided wards. There is no identifiable relationship between the design of a ward and the way it is staffed. On the other hand, every hospital has proportionately more staff in wards with few beds than in wards with many beds. This separation of common practice from individual practice made possible the development of a formula which for the first time permitted comparison between hospitals with some assurance that like was being compared with like. Such studies by Department teams link with other work within and outside the Department's financed programme. Examples of other work come from studies of work-load (10) and the work-force (11, 12) and of the use of non-nursing personnel (13, 14), of centralized services (15, 16), of mechanization of work (17), of improved equipment (18), and in the conservation of nursing skills.

The Department's policy in developing research into nursing problems has three interwoven strands. First, the development of a programme of research relevant to the needs of the service, both by financing research projects likely to illuminate particular problems, fill gaps in existing work, or carry existing work a stage further, and by developing research groups to take a continuing interest in particular subjects. These groups are of particular importance because of their potential in providing more coherent research programmes, developing research methods, and acting as resource centres to provide information and training facilities. They may be concerned with nursing problems, NHS problems, or the application of research methods of a particular discipline to a wide range of field problems.

Second, research into nursing problems is held back as described in this paper by the gap in research work and consequent absence of

prepared research workers with a knowledge of the field. For this reason a vital element in the Department's programme is the provision of opportunities for research workers, nurses, and others, to develop skills and knowledge in this field.

The third strand relates to the need to develop channels of communication through courses, conferences, and publications so that the end results of the research process can be assimilated into practice.

REFERENCES

1. *Annual Report of the Department of Health and Social Security* (1969). Cmnd 4462 (London: HMSO).
2. DEPARTMENT OF HEALTH AND SOCIAL SECURITY (1969). *On the State of the Public Health* (London: HMSO).
3. KOPF, E.W. (1961). 'Florence Nightingale as statistician', *Quarterly Publication of the American Statistical Association*, NS **15**, 404.
4. MACGUIRE, JILLIAN (1970). 'Nurses and graduates 1 and 2', *Nursing Times Occasional Papers*, **66**, 41, 45.
5. —— (1969). *Threshold to Nursing*, Occasional Papers on Social Administration no. 30 (London: G. Bell & Son).
6. HOUGHTON, HAZEL (1968). 'Problems of hospital communication, an experimental study', in McLachan, G. (ed.), *Problems and Progress in Medical Care* (Oxford University Press for the Nuffield Provincial Hospitals Trust).
7. LEY, P., and SPELMAN, M.S. (1967). *Communicating with Patients* (Staples Press).
8. NUFFIELD PROVINCIAL HOSPITALS TRUST (1953). *The Work of Nurses in Hospital Wards* (London: Nuffield Provincial Hospitals Trust).
9. OXFORD REGIONAL HOSPITAL BOARD (1967). *Measurement of Nursing Care*, Operational Research Unit Report no. 9 (Oxford: Oxford Regional Hospital Board).
10. MOORES, B. (1970). 'The effect of length of stay on nursing work load', *Internat. J. Nursing Stud.* **7**, 81.
11. AULD, M.G. (1967). 'An investigation into the recruitment and integration of part-time nursing staff in hospitals', ibid. **4**, 119.
12. DONALD, B.L. (1966). *Manpower for Hospitals* (London: The Institute of Hospital Administration).
13. Abstracts of Efficiency Studies and the Hospital Service (1969). *Work in Outpatients Departments. The Allocation of Duties between Trained Staff, Auxiliary Nurses, and Domestic Staff* (London: HMSO).
14. CALDER, G., and BARNETT, J.J. (1967). 'Prescribing and administering drugs in hospitals. The pharmacist in the ward', *Pharmaceut. J.* **198**, 584.
15. Abstracts of Efficiency Studies and the Hospital Service (1969). *Central Sterile Supply*, nos. 130 and 131 (London: HMSO).
16. STRINGER, A. (1968). 'Central linen service for hospitals. Seven possible variations to suit local conditions', *Power Laundry and Cleaning News*, **118**, 784A.

17. GOLD, R.G. (1969). 'Planning a patient monitoring installation', *Bio-medical Engng*, **4**, 20.
18. NORTON, D. (1970). *By Accident or Design* (Edinburgh: E. & S. Livingstone).

8. Research in social work

E. M. GOLDBERG
Director of Research, National Institute of Social Work Training

The Seebohm Report pointed to many gaps and deficiencies in the personal social services and argued forcibly that these services should be extended and improved and that their administration should be more unified and professionally responsible. The Local Authority Social Services Act has implemented most of the report's recommendations in establishing unified social service departments with their own chief officers in local authorities.

At the same time there is still much uncertainty about the aims and subject matter of social work and many well-informed people still ask 'what do social workers do?' and 'how effective are they?' Social work training until quite recently was largely concerned with the development of casework skills. Barbara Wootton (1) in her famous attack on social casework, Scott Briar in his article entitled 'The casework predicament' (2), and Sinfield in a recent Fabian pamphlet (3) have all deplored the modern social worker's concentration on what they consider a narrow therapeutic role. They have taken him to task for preoccupation with the casework process and the client–social worker relationship which deflects attention from environmental problems created by bad social conditions. Thus, it has been argued, the criteria for success, are the social workers' own and not their clients'.

Studies of medical social workers (4, 5) have partly confirmed these views and so has the first British study of social work clients (6). Davies's recent investigation of probationers (7) suggests that social workers apply their skills most successfully to those who need them

least and that the psycho-therapeutic model of social work based mainly on the exploration of the client worker relationship may not be appropriate in certain types of case.

The validity of cherished notions about casework methods, for instance the superiority of long-term casework, has recently been challenged by the findings of a well-designed experimental study into brief and extended casework (8). This indicated that families experiencing serious problems in their relationships who received help limited to eight interviews made more progress than similar families who had long-term treatment.

The vagueness of the descriptions of what social workers actually do and of the aims they pursue has contributed to the difficulties of assessing outcome in relation to methods of help. Evaluation is an even more formidable task if one considers the vast expanse of human misery with which social workers are called upon to deal.

Further, the social workers' basic education is largely in the humanities and an important part of their training consists in helping them to achieve insight into their own and other people's functioning. Problems of measurement or search for objective evidence of the assumptions on which casework knowledge is based do not occupy a central place in the curriculum. Indeed, putting people into categories and quantifying phenomena, which in the last analysis are subjective experiences, cut right across the social worker's belief in the uniqueness of individual experiences and the need to individualize problems rather than to generalize, in order to help people in their difficulties. However, attitudes are changing slowly and, as the profession of social work develops, it begins to recognize the need to build knowledge on theories which can be tested by empirical research. Researchers for their part are trying to grapple with the formidable problems of investigating the dynamic, shifting, and ill-defined field of interaction between client and social worker and the many mediating functions which go under the name of social work.

The Department of Health and Social Security is concerned with the work of the social service departments and has for some years sponsored investigations into social work; for example into workloads of social workers, into more detailed processes of social work with specific groups of clients and, most important, has supported the first British field experiment which set out to test the effectiveness of social work.

GENERAL PATTERNS OF SOCIAL WORK

In a study of the work-loads of social workers in a 10 per cent random sample of local authority health and welfare departments in England and Wales and in all welfare departments in Northern Ireland, fieldworkers and their immediate supervisors kept records of their activities for a fortnight in structured diaries. These social workers also completed questionnaires on their own personal educational and professional background and on their attitudes to their work-loads.

The over-all proportions of social workers in the three main qualification categories were almost identical with the national figures reported by the Department of Health and Social Security; that is to say, about a quarter had full professional qualifications, another quarter had basic social science qualifications only or a training in specialized skills for helping the blind or the deaf, and half were untrained.

The investigation was designed to be comparable with a study carried out by the Home Office Research Unit on work-loads in children's departments (9). The most striking finding emerging is that over the country as a whole the proportion of time spent on different kinds of activities is very similar in children's and in health and welfare departments. For example, the time occupied in contact with clients and others directly concerned with their problems accounted for 30 per cent of all working time in the health and welfare departments and for 28 per cent of time in children's departments. The proportion of all working time devoted specifically to discussion with clients was 19 per cent in health and welfare departments and 20 per cent in children's departments. Travel accounted for 16 per cent of the time worked in health and welfare departments and for 17 per cent of the time in the children's departments. The variations between departments were not very marked and questions arise about possible reasons for this extraordinary uniformity of patterns in social work activities in the three major statutory services taken over the country as a whole.

An examination of the amount of time devoted to different types of cases in the health and welfare departments showed that the mentally ill took up the largest proportion of time spent in contact with clients and others directly concerned with their problems, namely 25 per cent, followed by the blind, 20 per cent, and by the elderly, 19 per

cent. Twelve per cent of contact time was taken up by the physically handicapped. Thus these four main categories of cases accounted for just over three-quarters of all case contact time. Seven other types of cases contribute to the remaining quarter but only the mentally subnormal and problem families account for 5 per cent or more each of the total contact time.

A further study examines in more detail a one-day sample of each officer's cases during the fortnight. It will be possible to report on some basic characteristics of this national sample of some 2,000 clients, what their problems were, how long they had been in contact with the department, what methods of help were used and how these factors relate to the training and seniority of the social workers concerned.

SOCIAL WORK WITH SCHIZOPHRENIC PATIENTS AND THEIR FAMILIES

Community care for the mentally ill remains a burning topic and social work forms an important part of this care. Partially recovered schizophrenic patients who go in and out of hospital pose particularly difficult problems of rehabilitation. Thus, one study of social work activities supported by the Department of Health and Social Security is concerned with exploring and demonstrating ways of containing chronic schizophrenic patients within their families. This investigation is carried out from a London mental hospital with patients and their families resident in one inner London borough. Intensive social work support which is carefully recorded is provided by a skilled and experienced social worker for a period of at least eighteen months. Independent assessments of the patients' condition and behaviour, the relatives' feelings about the illness, the burden it imposes on them, and their opinions about the help they are receiving are carried out at the beginning, at mid-point and at the end of the helping period.

The sample consists of about fifty patients and their families. Two-thirds are married women and nearly half of the households contain children under school age. At any one time at least one-third of these families present acute problems which centre mainly around marital conflicts, housing difficulties, and work problems. The burdens which husbands of chronic schizophrenic wives carry stand out starkly and so do the physical and emotional deprivations

suffered by many children in these households. Consistent social work with these families is very demanding; crises are common and skilled collaboration with many other social and medical agencies is often necessary. The study also demonstrates how organizational difficulties such as turnover and re-allocation of staff can militate against successful contact between relatives and hospital personnel; it also illustrates the confusing situations which often surround the medical after-care of these patients.

Eventually it is hoped to describe and evaluate the kind of social work support which proved helpful in these chronic situations and where social work failed to make a contribution. The results will also demonstrate the gaps in social and medical provision which add to the difficulties of caring for these seriously disturbed families.

SOCIAL WORK IN GENERAL PRACTICE

The Department has for some time been interested in the possibilities of attaching social workers to general practice. One such project, whose main financial support has come from the City Parochial Foundation but which has received much attention and encouragement from the Department, was the attachment of a social worker to a group general practice in North-west London (10). Interesting features emerged about the client population which resembled those found in a similar project in Barnstaple (11). Twice as many women as men were referred to the social worker, a third of their social work patients were over the age of 60, and nearly two-thirds of the clientele were either single, widowed, or divorced. However, the social class distribution was similar to that of the area of residence. General practice proved to be an excellent 'pick-up' point at which psychosocial problems could be identified among all social groups.

An important role of the social worker was to be a link with and interpreter to a wide variety of social agencies in the community, both statutory and voluntary. Her educational role was considerable in extending the team's knowledge of the social facilities in the community. The social work carried out in the practice was usually of a short-term nature, being less than three months in duration and involving fewer than ten interviews. The tendency of the GP to take speedy decisive action and the patients' expectations led the social worker to adapt the traditionally rather slow and tentative methods of casework to quick action in crisis situations.

The implications of this and other projects for the deployment of social workers are manifold and have formed the subject matter of joint discussions between the National Institute for Social Work Training and the Royal College of General Practitioners. Full-time attachments of social workers to big health centre practices are visualized, part-time attachments to smaller practices have been in existence for some time. In addition various patterns of referral and liaison between GPs and social service departments are bound to evolve according to local needs and resources.[1]

THE EFFECTIVENESS OF SOCIAL WORK WITH THE AGED

The investigations into social work described so far are largely descriptive, although the study of schizophrenic families has an important evaluative component consisting of assessments before, during, and after treatment which are carried out by an independent observer, using operationally defined criteria for measuring behaviour and attitudes. The most stringent test of effectiveness of social work is, of course, a controlled experiment in which two similar groups of clients receive different types of help. So far such experimental studies, all of them carried out in the USA, have been disappointing in their results. They have shown very small, if any, gains among the experimental groups which had received skilled casework or other forms of special social help.

The field experiment supported by the Department was the first British attempt to assess the effectiveness of social work in a specific field—that of the aged (12). The team, led by a social worker and including a physician and a statistician, assessed the social and medical conditions of 300 applicants aged 70 and over to a local authority welfare department and determined their needs for help. These welfare clients were found to be more incapacitated than random samples studied in similar age-groups in Britain. A quarter were suffering from a serious disease which constituted a threat to life and 15 per cent from psychiatric disorders. Nearly half were living in unsuitable or inconvenient housing and two-thirds lived alone. Children and neighbours were in frequent contact with the old people and very few were found to be socially isolated. Although half the sample were already receiving some personal social services before their contact

1. *Editor's note.* Other studies are being carried out on this particular question—see List no. 1018.

with the welfare department, the medical and social assessors uncovered many additional medical and social needs. Only 5 per cent appeared to be in need of residential care.

These 300 welfare clients were randomly allocated to a 'special' group and a 'comparison' group which proved to be reasonably well matched in almost all important respects. Two trained caseworkers were appointed to take on the social work in the special group, while the comparison group remained under the care of the department's welfare officers, none of whom had a professional social work training.

An attempt was made to measure the amount and quality of the social work offered; these were found to differ greatly in the two groups. The old people in the special group received twice the amount of help compared with those in the comparison group. This is partly related to the fact that the welfare officers with the comparison group carried bigger case-loads. The trained social workers saw more problems and laid more emphasis on casework, including work with relatives. They worked more closely with medical and voluntary agencies; they made greater efforts to enrich their clients' lives by introducing them to clubs, encouraging holidays and outings, and by drawing in volunteers. They worked more selectively, according to people's needs.

After ten and a half months the social and medical assessors reassessed all the survivors remaining in their own homes on the same criteria as on the first occasion, not knowing who were in the special and comparison groups and not having access to their previous assessments. Few, if any, changes had occurred in the clients' material living conditions. Not surprisingly with people of this age, the general health of both groups had deteriorated. Their mobility, their capacity to perform basic tasks of everyday living and contacts with relatives and neighbours had remained virtually the same. However, there were also some changes for the better: both groups had significantly fewer practical needs on reassessment and this was even more apparent among the clients in the special group. The clients in the special group had also improved significantly in their 'morale', whereas this did not happen in the comparison group: more old people in the special group were attending clubs, had had a holiday, felt satisfied with life, had a positive attitude to the world around them, had fewer worries and personal problems at the end of the

experiment than at the beginning. They were also significantly more active and less depressed than the old people in the comparison group. In addition to these statistically significant differences many movements and differences in outcome were observed, small in range, which consistently favoured the special group. In most respects one could see a close correspondence between the input recorded by the social workers and the outcome reported by the clients or judged by the independent assessors. The clients' own perceptions and evaluations of the help they had received from the social workers during the experimental period also revealed significant differences between the groups. A significantly higher proportion of clients in the special group felt that the social workers' visits had been of help to them. These clients' spontaneous comments showed more warmth towards their social workers, greater perception of their personalities and more awareness of the support and caring nature of their relationships with them. The old people in both groups mentioned a great variety of practical help they had valued but the clients in the special group referred to almost three times as many helpful practical services performed by the social workers as the clients in the comparison group.

The conclusion was reached that the less-trained social workers of the welfare department achieved a good deal, though not as much as their trained colleagues in alleviating their clients' practical needs. Unlike their untrained colleagues, the trained workers also brought about some improvement in their clients' activities and in their feelings and attitudes and these assessments found confirmation in the clients' own reactions and comments about the help they had received.

The study suggests that if social workers were prepared to define their goals in more precise operational terms, to describe and where appropriate to categorize and measure their social work activities, to tolerate independent assessments and to heed their clients' own evaluations, then considerable progress could be made in social work research. One could gradually get closer to determining the relative effectiveness of different types of intervention in different situations. Deployment of limited resources, including those devoted to training, could then be based, at least partially, on tested evidence.

ACTION STUDIES IN SOCIAL SERVICE DEPARTMENTS

Further studies which will be supported by the Department will attempt to carry some of the lessons learned from this experiment into the wider field of social service activities at area office level in a new social service department. The intention is to carry out in one selected area more systematic studies of 'consumers' of social work; to collaborate with the local authority planning department in assembling information on 'social needs', using and developing social indexes of need from various sources; to work towards standardized records which will give information on the characteristics of the client population, problems presented, action taken, and aims achieved and to test out monitoring systems. A further aim is to develop more efficient ways of deploying scarce skilled social work resources by identifying those situations in which less-skilled help can be used, such as welfare assistants, home helps, volunteers, and self-help groups in the community. Similarly, it is hoped to determine gradually those areas of need in which highly specialized social work skills are required.

APPLICATION OF RESEARCH FINDINGS TO SOCIAL WORK PRACTICE AND TEACHING

It is particularly valuable and important to carry out research in an institute which provides advanced courses for both senior social work practitioners and teachers of social work. For the last four years seminars have been especially devoted to the evaluation and use of empirical research findings in practice and in teaching. Students show increasing eagerness to keep in touch with current research and to find out more about its methods.

Editor's note. All the studies quoted in this paper are being carried-out at the National Institute of Social Work Training.

REFERENCES

1. WOOTTON, BARBARA (1959). *Social Science and Social Pathology* (Allen & Unwin).
2. BRIAR, SCOTT (1968). 'The casework predicament', *Social Work*, **13**, no. 1.
3. SINFIELD, ADRIAN (1969). *Which Way for Social Work?*, Fabian Tract 393 (Fabian Society).
4. MOON, MARJORIE (1965). *The First Two Years* (Institute of Medical Social Workers).

5. BUTRYM, ZOFIA (1968). *Medical Social Work in Action*, Occasional Papers on Social Administration no. 26 (Bell).
6. MAYER, JOHN E., and TIMMS, NOEL (1970). *The Client Speaks* (Routledge).
7. DAVIES, MARTIN (1969). *Probationers in their Social Environment* (HMSO).
8. REID, W.J., and SHYNE, ANN W. (1969). *Brief and Extended Casework* (New York: Columbia University Press).
9. HOME OFFICE RESEARCH UNIT (1969). *Workloads in Children's Departments* (HMSO).
10. GOLDBERG, E.M., NEILL, J., SPEAK, B.M., and FAULKNER, H.C. (1968). 'Social work in general practice', *Lancet*, ii, 552–5.
11. FORMAN, J.A.S., and FAIRBAIRN, E.M. (1968). *Social Casework in General Practice* (Oxford University Press for the Nuffield Provincial Hospitals Trust).
12. GOLDBERG, E.M., MORTIMER, A., and WILLIAMS, B.T. (1970). *Helping the Aged: A Field Experiment in Social Work* (Allen & Unwin).

9. A national dental survey

JEAN E. TODD
Senior Social Survey Officer
Office of Population Censuses and Surveys

By the mid 1960s the need for information about the use made of the General Dental Service of the NHS was becoming clear. A lot of information has always been available about the total amount of treatment carried out under the NHS in any one year because the payment system used for the General Dental Service has always been one which involved payment to each dentist for the actual items of treatment that he carried out. Unfortunately this information about treatment provides no indication of the dental health of the community because people who have had two courses of treatment in one year will contribute to the statistics twice and those who have not attended the dentist during that year will not be counted at all. To establish how dental treatment has been distributed within the community it is necessary to select a random sample of the general population and examine their dental condition.

It was to obtain such a measure of the dental health of the community that the Department commissioned this survey. Two organizations, the Government Social Survey Department[1] and the London Hospital Medical College Dental School were involved since two areas of experience were required. The former is a government department which specializes in carrying out national sample surveys for other government departments or committees of inquiry. It has permanent resources which enable large-scale national surveys to be mounted and a permanent staff of trained interviewers together with

1. Now the Social Survey Division of the Office of Population Censuses and Surveys.

facilities for sampling and for processing the data, but it had no experience of dental work. The London Hospital Medical College Dental School, on the other hand, had dental resources and some experience of epidemiology in the dental field (1).

A detailed account of the methods used in the survey can be found in the published report (2) but in essence the project was as follows. A sample of over 3,000 adults was randomly selected from fifty parliamentary constituencies using the Electoral Register as a sampling frame. There are very few natural fluoride areas (where the concentration reaches 1 part per million) so in a national sample of adults aged 16 or more very few would have been exposed to either natural or artificially fluoridated areas. It was not therefore possible to investigate the effects of fluoride in this study. The selected people were to be interviewed about their dental experiences, habits, and behaviour and when possible, and at a later date, examined. The fieldwork was completed in the two months, May and June 1968. To carry out this operation 125 interviewers were used together with a team of 44 dentists. The interviewers were already employed by the Government Social Survey Department and were trained for this type of work, requiring only some briefing for this project. However, dentists had both to be recruited and briefed for this study. An advertisement was put in the dental press and all the dental schools in England and Wales were approached. Most of them took a keen interest in the inquiry. A fairly high proportion of the team of dental examiners came from the dental schools. The dentists selected to work on the inquiry attended a course of instruction in London during which they learned the criteria upon which the dental examination was based, and practised applying these criteria. They were also tested as to the reproducibility of performance using a standardized examination technique.

When the fieldwork started this dental examination was to be carried out for all those people in the sample who were interviewed and were willing to have a dental examination. This was the case whatever the person's dental status, so the examination information included data about full denture wearers as well as people who still had some natural teeth.

The examination took place not in a dental surgery but in the person's own home, the dentist in this inquiry going to the people, not the people to the dentist. One problem at the planning stage was

how to record the dental examination data in the home situation. At one stage it was thought possible that a team of dental recorders might have to be recruited and trained. Eventually, however, it was decided to train the Government Social Survey interviewers to be dental recorders. In their capacity as interviewers they were already skilled in recording data and therefore for the purpose of this inquiry their training was extended to include this extra function of recording the dentist's findings.

Using the interviewers as dental recorders had many advantages beyond solving the problem of how to record the dental data. First and foremost it meant that on the return call, to carry out the dental examination, one of the dental team was not a stranger. This was a great help, for many people are apprehensive about the thought of a dental examination. A familiar face in the dental team kept apprehension to a minimum. In addition, the interviewer was accustomed to working in people's homes whereas the dentist was not. She was therefore able to cope with the introductions and so on, while the dentist concentrated on making the necessary preparations for his examination.

The amount of co-operation obtained from the public in this inquiry was gratifyingly high, 85 per cent of the initial sample were interviewed and 77 per cent were both interviewed and examined.

The most fundamental way in which this project was novel was that, in a nationwide study of a random sample of the adult population, information was collected about the actual state of dental health established by a dental examination. This dental information could then be analysed in conjunction with what was learned from the interview about the person's attitude to dentistry and his general dental behaviour. Although this kind of research had previously been carried out for particular localities or particular occupational groups, this was the first time that a measure of community dental health had been attempted on a national scale in England and Wales. The results of the survey were published in March 1970. They were presented in non-dental language, for they are of interest not only to the dentist but also to the administrator and to the private individual. Every person, at least to start off with, has teeth, and most people suffer from dental decay. The survey only found a 'perfect mouth' in 3 per 1,000 adults. Thus the dental problem is not one of who suffers from disease but of the extent to which people suffer, and of how the disease has been treated.

One simple measure used in the report to establish community dental health was the proportion of people who had no natural teeth left at all. Obviously complete loss of teeth is the ultimate failure of restorative dentistry. In England and Wales, among adults aged 16 or more, 37 per cent had no natural teeth at all. It is difficult in isolation to interpret the importance of this figure but when the same proportion is calculated for different regions of England and Wales the importance of such a measure emerges. In London and the South-east 28 per cent of adults had no natural teeth, in the North[1] 45 per cent had no natural teeth.

Total tooth loss was further examined for different age-groups, different social classes, and for males and females separately. Although these factors were very important and showed considerable association with total tooth loss, a large regional variation persisted independent of sex and social class and age.

YOUNG DENTATE ADULTS

Since this regional variation was still currently evident among the young, in whom the amount of total tooth loss is still relatively small, the study team turned to an examination of the dental state of young adults who still had some natural teeth. Once a person has lost all his natural teeth there is no longer any evidence relating to his dental state before the final extractions. But among the young adults who still have some natural teeth there must exist those people who are the next potential full denture wearers. The factors leading to the phenomenon of a large regional difference in total tooth loss should therefore be observable among this group of young adults who still have some of their natural teeth.

On examination of the data for young dentate adults in England and Wales it was found that two major but entirely different patterns of dental behaviour existed among this group. On the one hand there was a large group, 45 per cent, who attended the dentist for a regular check-up. On the other hand there was another large group, 41 per cent, who only went to the dentist when they were having trouble with their teeth. If looked at regionally, the groups are still quite large but there are fewer regulars and more irregulars in the North,

1. The north comprised the three economic planning regions, Northern, North-west, and Yorkshire and Humberside.

and more regulars and fewer irregulars in London and the South-east, compared with the average for England and Wales as a whole.

When regular attenders were asked what treatment they would prefer if they had an aching back tooth, 8 out of 10 said they would prefer it filled. When the irregular attenders were asked the same question only 3 out of 10 said they would prefer the tooth to be filled. This treatment preference was also examined regionally. Among regular attenders there was no difference regionally, but among irregular attenders there was. Only 2 or 3 out of 10 irregulars in the North said they would prefer the aching back tooth to be filled, but 4–5 out of 10 irregulars in London and the South-east expressed preference for restorative dentistry.

Table 1. Attendance pattern by region (percentage)

	Adults aged 16–34 with some natural teeth				
Attendance pattern	*North*	*Wales and South-west*	*Midlands and East Anglia*	*London and South-east*	*England and Wales*
Regular check-up	38	43	46	51	45
Occasional check-up	15	18	8	14	14
Only when having trouble with teeth	47	39	46	35	41
	100	100	100	100	100
Base	226	107	186	297	816

During the interview, information was obtained about the kind of treatment each person had the last time he or she went to the dentist. This information was examined in relation to whether any fillings or any extractions were carried out. Among regular attenders fewer than 1 in 10 people had treatments which involved extractions. Among irregular attenders 7 out of 10 had some extractions in their last dental treatment. Among regular attenders there was no regional variation but again among irregular attenders there was. In London and the South-east 56 per cent of young adult irregulars had some extractions. This proportion can be divided into 26 per cent who had treatment involving both extraction and filling and 30 per cent whose treatment involved no restorative work. In the North 70 per cent of young adult irregulars had some extractions, 25 per cent had treatment involving both extraction and filling but there were 45 per cent whose treatment involved no restorative work.

The information collected from the dental examination enabled an analysis to be made of what the accrued effect of these young adults'

dental treatment had been over their lives so far. Two simple indicators are useful for this purpose. Firstly, what proportion have 6 or more filled but otherwise sound teeth, and secondly what proportion have no teeth in this category. Among regular attenders about 9 out of 10 had 6 or more filled teeth. Among irregulars 3 or 4 out of 10 had that number of filled teeth. Among the irregular attenders there was again a large regional difference. In London and the South-east just over a half of irregulars had 6 or more filled teeth, in the North just over a quarter had this number of filled teeth. Complete absence of sound restorations was very infrequent among regular attenders, only of the order of 1 person in 100. Among irregulars in London and the South-east about 1 in 10 had no teeth in a currently adequate restored state; in the North, however, as many as 4 out of 10 young dentate adults had no teeth that were filled but otherwise sound.

CONCLUSIONS

The dental future for irregular attenders is obviously not as good as that for regular attenders, but as far as the regional variation is concerned it is the disparity in the amount of restorative treatment among irregular attenders in the different regions that plays a major part in determining the rate of total tooth loss. Is there any evidence of why this disparity occurs?

For a long time the distribution of dental manpower throughout England and Wales has not been proportionate to the spread of the population. From the survey, information was obtained about the attendance patterns of the general population. It was therefore possible to calculate the proportion of all people who are regular attenders in the different regions.

By applying the proportion of regular attenders to the population per dentist it can be seen that the regional variation in the proportion of regulars results in dentists having, on average, about the same

Table 2. Average number of regular attenders (all ages) per dentist, regionally

Survey regions	*Population per dentist*	*Survey proportion of regular attenders*	*Regular attenders per dentist*
North	5,750	20	1,150
Wales and South-west	6,070	19	1,150
Midlands and East Anglia	4,840	25	1,210
London and South-east	3,290	31	1,020

number of regular attenders irrespective of the region in which they work.

It is therefore consistent with the population/dentist ratios that the survey results showed a great disparity between the dental health of young dentate irregular attenders in the different regions, since the disparity in population/dentist ratios in the different regions has to be absorbed among the less dentally cared for. This variation in the amount of restorative work carried out must ultimately lead to an accelerated rate of total tooth loss following the same regional pattern.

EPILOGUE

Two months after the survey was complete a postal inquiry was carried out to see whether participants had been influenced in their attendance at dentists' surgeries. An 86 per cent response was received from a random sample of 100 dentate adults who had not been to the dentist for a year or more. Ninety per cent of responders had made no appointment to see a dentist in spite of an interview, examination, and a leaflet recommending regular attendance.

REFERENCES

1. BULMAN, J.S. *et al.* (1968). *Demand and Need for Dental Care: A Socio-dental Study* (Oxford University Press for the Nuffield Provincial Hospitals Trust).
2. GRAY, P.G., TODD, J.E., SLACK, G.L., and BULMAN, J.S. (1970). *Adult Dental Health in England and Wales in 1968* (HMSO).

10. Fluoridation of water

A. E. MARTIN

As far back as 1874, an association was suspected between the presence of fluorides in drinking water and a lowered prevalence of caries in both deciduous and permanent teeth; yet it was not until 1930 that the presence of small amounts of fluoride was demonstrated in the water supplies of areas with a high incidence of dental mottling and a low incidence of dental caries. Subsequently Trendley Dean, in a series of investigations over the period 1933–54, defined those levels of fluorides in drinking waters of the USA which were associated with problems of dental fluorosis (mottling), and those which were associated with the inhibition of dental caries. Meanwhile confirmatory studies were being reported from many countries. In the UK as early as 1933 Ainsworth (1) had demonstrated the existence of dental mottling in Essex and had shown that the condition together with a lowered incidence of caries was occurring in an area with 3·5–5·0 parts per million (ppm) of fluoride in the drinking water. Weaver (2) in a comparison between North and South Shields showed that in the latter area, which then had 1·4 ppm fluoride in its drinking water, there was less caries than in North Shields with only 0·25 ppm. Forrest, Parfitt, and Bransby (3) similarly showed the same effect in other areas of the country and Forrest (4) showed that mottling was not a problem in areas of this country having approximately 1·0 ppm fluoride in their drinking water supplies. Similar results were obtained by Forrest and James (5) in the Anglesey fluoridation area.

In 1945–6 the fluoridation of water supplies was commenced in three North American towns and by 1951 fluoridation had become

common practice in many parts of the USA. A mission was therefore sent to the USA to review the evidence for the fluoridation of water supplies and to recommend what action, if any, should be taken in this country. Its report (6) described fluoridation as a useful method of reducing dental caries but recommended that before it was adopted as a policy, studies should be carried out in selected areas within the UK to confirm the benefit to teeth and establish whether there were any adverse effects. The health departments, in consultation with the MRC, established a research committee and a programme of studies was agreed.

With the agreement and co-operation of local authorities study areas were selected in which fluoridation was to be carried out while other similar areas were selected as controls. Preliminary dental examinations of children were made in both the study and control areas. Water engineers in co-operation with industry designed suitable apparatus, particular attention being paid to the maintenance of a consistently steady level of fluoride. The study areas selected were Watford, Andover, and Kilmarnock with Sutton, Winchester, and Ayr as their respective controls, and in a fourth study area, Anglesey, one-half of the island was to receive fluoridated water, the other half being reserved as a control. Fluoridation was started in 1955–6, but unfortunately was discontinued by the Borough of Andover after two years and by Kilmarnock after six and a half years. In Anglesey the local authority decided to fluoridate the water supply for the entire island including the control area in 1964. Care was taken to ensure that a standard method of examination was adopted by the examining dental officers and for this reason the results between different areas are comparable throughout the years under review. They have been published in two reports (7, 8). The full effects of fluoridation are only apparent when fluoridated water has been consumed during the whole period of tooth formation, and the five-year report therefore shows the full effects of fluoridation only in children aged 3 and 4 years. It demonstrates a 64 per cent reduction in decay in 3-year-olds and 54 per cent in 4-year-olds when the figures for the three study areas are combined. The eleven-year report completes the picture for the temporary dentition and shows effects on the permanent dentition of children aged 8, 9, and 10. Over the age-range 3–7 years there was a total reduction of 55 per cent in the number of decayed deciduous teeth in the study areas (compared with the baseline

examination) against only a 19 per cent reduction in the control areas. For the permanent dentition the figures were 36 and 5 per cent reduction in carious teeth in the study and control areas respectively.

Although these statistics relate only to Watford and Anglesey, there are figures available from Kilmarnock where fluoridation was terminated in October 1962 (after six and a half years). The Kilmarnock figures are quoted in an interesting postscript to the eleven-year report, which describes the benefit to children who received fluoride during the period of tooth formation and calcification. Those born subsequently who did not have the benefits of fluoridation have a pattern of dental decay which resembles that which was prevalent before fluoridation started. Evidence from other countries is reviewed in the eleven-year report and indicates that the benefits of fluoridation will be continued throughout the greater part of adult life. In the later decades the benefit is not so obvious since it is periodontal disease rather than dental caries which is responsible for the greater part of tooth mortality. The report adds that too much importance should not be attached to the study of individual areas in isolation, for the strength of the case for the fluoridation of water supplies lies not in the results for any single place or any single country, but in the consistency of results from different parts of the world. In 1969 the 22nd World Health Assembly passed a resolution which endorsed the advantages and safety of the fluoridation of water supplies and recommended countries to explore the practicability of introducing it for populations where fluoride intake was below the optimal level.

Fluoridation as a preventive health measure can only be accepted if there is decisive evidence of its safety and this has been provided partly by a study of the metabolism and toxicology of fluorides and of the effects of industrial exposures, partly by a study of the health statistics of high and low fluoride areas, and partly by the investigation of possible associations with individual diseases. A vast amount of research has been carried out in countries throughout the world and more particularly in the USA where the early adoption of schemes of fluoridation necessitated careful studies of safety. In the UK an initial task of the research committee was to review the existing evidence and to recommend additional work where this appeared necessary. Most of the resulting investigations were carried out by members of the Department working sometimes with the medical

officers of health of the study areas and sometimes with other colleagues outside the NHS.

Among the investigations which were carried out was a study of mortality rates in areas of high and low fluoride waters, which showed that the over-all mortality rates were the same in both (9), the results confirming those of similar studies in the USA and USSR. Studies in Anglesey showed no relationship between school absenteeism or anaemia of pregnancy and the consumption of fluoridated water (10, 11). Other investigations made on behalf of the research committee showed no evidence of an increased incidence of perforated peptic ulceration (12) or of enlargement of the thyroid gland (13) as a result of the ingestion of fluorides.

An early investigation in the natural fluoride areas of East Anglia by Eley and his colleagues (14) failed to show any effect of water-borne fluorides on the incidence of osteochondritis juvenalis of the spine or of other spinal defects; neither could any interference with epiphyseal development be detected.

In a later investigation in the Watford fluoridation area, Ansell and Lawrence (15) found no evidence of any increase in rheumatoid or other arthritic conditions. An American worker using data which had obvious statistical defects had claimed to have found an association between fluoride drinking waters and mongolism (16–19) but a survey carried out by the Department in conjunction with a number of local authorities failed to establish any such connection in high fluoride areas of this country (20, 21).

Observations in the Far East had led to the suggestion that where the diet is inadequate, mottling of the teeth might occur with an intake of fluoride that would not have caused mottling among well-nourished persons. A study by a departmental team in natural high fluoride areas, however, showed no evidence that nutrition of the lowest level found in the UK during the years 1948–58 had any influence on the incidence of dental mottling (22).

The most recent series of investigations have shown that the amounts of fluoride likely to be taken into the body as a result of the inhalation of fluoride-polluted air is quite insignificant (23); neither would there be any hazard from the consumption of vegetables in the polluted areas of the country in which vegetable crops are grown (24).

The fluoridation studies are obviously of particular importance to the Department since the greater part of the country's dental

resources is deployed in the treatment of caries. The dental treatment of very young children poses particular problems and, if delayed, results eventually in even greater demands on dental manpower and resources. An economic assessment of the benefit from fluoridation has been carried out in the USA and showed that the cost of comprehensive dental treatment of children 5 and 6 years old in a fluoridated area was less than half that of the same age-group in an area without fluoride. The time taken to carry out comprehensive treatment on each child over a period of five years averaged only thirty minutes per year in the fluoridated area as compared with fifty-one minutes per year in the non-fluoride area.

The programme originally agreed by the research committee is now nearing completion. Published research on the subject has reached very large proportions and makes it possible to judge the degree of benefit to be expected both in children and adults and to confirm the absence of any hazard. Nevertheless, a careful watch continues to be maintained in the fluoridated areas and reports of new research are continually scrutinized and assessed to ensure that new developments of importance are not overlooked.

REFERENCES

1. AINSWORTH, N.J. (1933). *Br. dent. J.* **55**, 233.
2. WEAVER, R. (1944). ibid. **76**, 29.
3. FORREST, J.R., PARFITT, G.J., and BRANSBY, E.R. (1951). *Mon. Bull. Minist. Hlth*, **10**, 104.
4. —— (1956). *Br. dent. J.* **100**, 195.
5. —— and JAMES, P.M.C. (1965). Ibid. **119**, 319.
6. REPORT (1953). *The Fluoridation of Domestic Water Supplies in N. America as a Means of Controlling Dental Caries* (London: HMSO).
7. REPORT (1962). *The Conduct of the Fluoridation Studies in the U.K. and the Results achieved after Five Years*, Reps Publ. Hlth and Med. Subjs, no. 105 (London: HMSO).
8. REPORT (1969). *The Fuoridation Studies in the U.K. and the Results achieved after Eleven Years*, Reps Publ. Hlth and Med. Subjs, no. 122 (London: HMSO).
9. HEASMAN, M.A., and MARTIN, A.E. (1962). *Mon. Bull. Minist. Hlth*, **21**, 150.
10. GRIFFITH, G.W. (1961). *Med. Offr*, **106**, 393.
11. —— (1963). *Mon. Bull. Minist. Hlth*, **22**, 30.
12. NISBET, B.R. (1962). In *The Conduct of the Fluoridation Studies in the U.K. and the Results achieved after Five Years*, Reps on Publ. Hlth and Med. Subjs, no. 105 (London: HMSO).

13. BERRY, W.T.C., and WHITTLES, J.H. (1963). *Mon. Bull. Minist. Hlth*, **22**, 50.
14. ELEY, A.J., KEMP, F.H., KERLEY, P.F., and BERRY, W.T.C. (1957). *Lancet*, **ii**, 712.
15. ANSELL, B.M., and LAWRENCE, J.S. (1966). *Ann. rheum Dis.* **25**, 67.
16. RAPAPORT, I. (1956). *Bull. Acad. nat. Med. (Paris)*, **140**, 529.
17. —— (1959). Ibid. **143**, 367.
18. —— (1961). Ibid. **145**, 450.
19. —— (1963). *Rev. de Stomatologie*, **46**, 207.
20. BERRY, W.T.C. (1958). *Am. J. ment. defic.* **62**, 634.
21. —— (1962). *Med. Offr*, **108**, 204.
22. ADCOCK, E.W., BERRY, W.T.C., and FORREST, J.R. (1958). *Mon. Bull. Minist. Hlth*, **17**, 54.
23. MARTIN, A.E. (1970). *Industrial Fluoride Hazards in Fluorides and Human Health*, Monograph Series no. 59 (Geneva: WHO).
24. —— and JONES, CHRISTINE M. (1971). *Publ. Hlth Reps (Wash.)* (to be published).

11. Coronary heart disease

GILLIAN R. FORD

A new development in treatment, whether it be for renal failure, Parkinson's disease, or leukaemia, may require not only a reorganization of existing services or development of new ones but also reappraisal of existing priorities. Assessment of the costs and manpower involved and the benefits that may be expected needs to be made, often in the absence of good data on incidence and prevalence or of the reproducibility of the results of the new treatment in centres other than those from which they have been reported.

A situation of this kind occurred when in 1964 and 1965 increasing numbers of reports from the USA, Australia, and the UK suggested on the basis of comparisons between case fatality rates in hospitals before and after the introduction of coronary care units that the mortality rate from acute myocardial infarction could be substantially lowered if patients were looked after in specially staffed and equipped intensive-care units under constant monitoring by trained staff, with facilities to deal urgently with irregularities of rhythm when these occurred.

The problem of whether to introduce some new form of treatment is in most instances a matter almost entirely for clinicians alone. However, with intensive coronary care its true value and the manner of its introduction clearly posed highly important questions about the best use of resources and medical priorities. Apart from the knowledge that coronary heart disease was obviously a major health hazard (causing 30 per cent of *all* deaths in men between the ages of 45 and 64), study of the growing literature on intensive coronary

care made it clear that there were still a number of important questions to be answered. For example, had the benefit of the new method of care as compared with conventional treatment been clearly established or should further research be undertaken? Assuming benefit from intensive coronary care could be demonstrated, was this commensurate with the additional resources required? Could an *optimum* level of staffing and equipment necessary to achieve this benefit be established? What facilities for intensive coronary care do hospitals require in relation to the population they serve? Could patients be grouped into those who would particularly benefit from intensive coronary care and those who do not require it or may even be harmed by it or by the preceding ambulance journey?

As a start to considering these and other questions the Department drew on the knowledge of a group of clinicians and epidemiologists with a particular knowledge of this disease who attended a special conference and from whose members a committee under the chairmanship of Lord Platt was formed in 1965. This committee set out the guidelines for a programme of research to try and find answers to some of these quite specific problems and also to discover more about the incidence and natural history of acute myocardial infarction in the community.

Lord Platt's group sponsored a series of studies some of which are complete and others nearly so. The opportunity of examining one particular question—that of whether as many patients with acute myocardial infarction as possible should be admitted to intensive coronary care or whether some fare as well at home—presented itself when Dr John Wright, a Bristol GP, and Dr Gordon Mather, a consultant physician, suggested a comparison between treating patients at home (as was common in general practice at the time) and in a hospital intensive care unit by a random allocation to either group. It was thought that this method, and the use of strict criteria for diagnosis, would control factors such as age and sex differences, delays between onset of symptoms and admission, or selection due to other reasons, all of which were known to influence hospital mortality rates and which affected to an unknown degree the favourable results reported from existing coronary care units on the basis of uncontrolled studies. From the outset it was realized that there would be difficulty in achieving a high level of randomization. Social reasons would preclude care being given at home in some instances. Also in

spite of their agreement to take part in a randomized trial GPs might feel that there were situations where medical and social factors combined to dictate both course and place of treatment. Patients in study practices seen during holidays, nights, or weekends by colleagues or locums would be unlikely to be in the random groups. The study would not have been acceptable to GPs if they had not had the freedom to randomize or to place in an elective group. Accordingly the study was planned so that patients from study practices whether in the two random groups or looked after electively at home or in hospital would have a standard record completed for them, standard diagnostic tests and examinations, and follow-up at fixed intervals. Dr Mather and Dr Wright were joined by other consultant and GP colleagues in the South-west prepared to do this difficult and time-consuming study; and linked trials were begun in four district general hospitals (Lists nos. 1010–13)—a not inappropriate setting for such a study bearing in mind that all district general hospitals are caring for patients with acute infarcts. Research medical officers were appointed at all four centres and they have been responsible for collecting and recording data for home as well as hospital patients. The multicentre trial in the South-west is now in its final year and it is hoped that analysis of the results in the random study and control groups may provide some indication of whether any particular groups of patients benefit from the special facilities in hospital, or whether others fare equally well, or better, at home. The data on patients in the elective hospital and elective home groups are being similarly analysed. Processing and analysis of the results are being carried out at the Institute of Biometry and Community Medicine at Exeter, as part of its centrally supported programme (List no. 3) of medical care research.

A rational approach to planning research on a particular disease or the services required to meet it is made easier when there are good data on its natural history. Prospective incidence studies at Oxford (1), under the aegis of Professor Acheson, then Director of the Oxford Record Linkage Study, and Edinburgh (2) (List no. 43) were sponsored by the Department and carried out in 1966–7 and have provided important data not previously available on various aspects of acute myocardial infarction as it occurs in the community: the proportion of patients treated at home and in hospital and the outcome, the accessibility of medical care agencies, as well as the rates in different age-groups and case fatality rate using different criteria for confirmation of diagnosis.

One striking finding of both studies confirmed what was first shown (for the UK) by Pemberton (3) in Belfast,[1] namely that over 60 per cent of all deaths occurring within four weeks of infarction were medically unattended (or 'sudden') deaths occurring outside hospital, and roughly 50 per cent of all these deaths within four weeks occurred within one hour of the onset of symptoms. Both Kinlen and Armstrong demonstrated that in the sequence of events occurring in the early stages of illness and admission to hospital a series of delays occurs, the greatest of which is between the onset of symptoms and the patient summoning his doctor. However, other delays, in the ambulance being called and arriving and in the admissions department of the hospital, contributed to the median delay between onset of symptoms and arrival in the coronary care unit totalling four hours in Edinburgh (4).

These dismal facts have led to efforts to get medical aid to the patient urgently at the place where the heart attack occurs. Following the pioneering work of Pantridge (5) in Belfast, using a mobile coronary care unit (as well as intensive-care facilities in hospital) to resuscitate patients with cardiac arrest and to treat and prevent irregularities of rhythm occurring early in the disease event, this method of care is being evaluated at Birmingham (List no. 1014) and Hammersmith (List no. 47). Kinlen's data emphasize that in a large proportion of deaths occurring outside hospital there are other factors operating which reduce the group who might benefit from mobile or hospital intensive care. Of the total of 156 deaths which occurred outside hospital in the Oxfordshire study, death was classified as sudden or unexpected, in that patients were not under care for this condition, in 130. However, not all this group of 130 would have been accessible to resuscitation by a mobile coronary care unit (had such a service been operating) since 59 deaths were not witnessed and a further 28 were over ten miles away from the hospital which would have been the base for such a service.

It seems that some other way of tackling the problem of sudden and early deaths must be found if real progress is to be made. The Department's programme of research in coronary heart disease has therefore recently expanded to include studies in prevention. A study is under way in Edinburgh (List no. 44) the purpose of which is to

1. Department of Health and Social Security research funds were not used in the Northern Ireland studies.

investigate the natural history of recent onset angina and to attempt to identify patients at special risk of dying suddenly within the next few days or weeks. Many workers have attempted to quantify the increased risk of developing coronary heart disease by the presence of certain factors, high blood pressure, smoking, obesity, lack of exercise, and high blood sugar in particular groups of people (6), and communities such as Framingham (7), Tecumseh (8), and Evans County (9). In London Dr G. A. Rose (List no. 66) has begun a controlled trial with the object of estimating the effect on coronary heart disease mortality and morbidity of implementing those measures which are at the present time thought to be beneficial in counteracting those factors shown to be adverse in epidemiological studies. The treatment group will receive health education aimed at dietary moderation, cessation of smoking, and regular exercise, together with treatment and advice to individuals selected after a preliminary screening examination as being at particular risk of developing coronary heart disease because of hypertension or hyperlipaemia or other factors.

Long-term follow-up with rehabilitation and after-care needs is the next subject for special study by the Department. At present data are accumulating on survival rates one year after infarction and on the time elapsing before patients return to work.

REFERENCES

1. KINLEN, L. (1969). DM thesis, held at the Bodleian Library.
2. ARMSTRONG, A., *et al.* (1970). In preparation.
3. PEMBERTON, J., and MCNEILLY, R.H. (1968). *Br. med. J.* **3**, 139.
4. FULTON, M., JULIAN, D.G., and OLIVER, M.F. (1969). 'Sudden death and myocardial infarction', *Supplement IV, Circulation*, vols. xxxix and xl.
5. PANTRIDGE, J.F., and GEDDES, J.S. (1967). *Lancet*, **ii**, 271.
6. HEADY, J.A., MORRIS, J.N., KAGAN, A., and RAFFLE, P.A.B. (1961). 'Coronary heart disease in London busmen', *Brit. J. prev. soc. Med.* **15**, 143.
7. KANNEL, W.B., KAGAN, A., DAWBER, T.R., and REVOTSKIE, N. (1962). 'Epidemiology of coronary heart disease', *Geriatrics*, **17**, 675.
8. EPSTEIN, F.H. (1965). 'Epidemiology of coronary heart disease', *J. chron. Dis.* **18**, 760.
9. MCDONOUGH, J.R., HAMES, C.G., STUBBS, M.S., and GARRISON, G.E. (1965). *J. chron. Dis.* **18**, 443.

12. Innovations in care: treatment of hernia and varicose veins

GILLIAN R. FORD

'Common things are commonest' may be true of clinical conditions in general and hospital practice but is not always so true within the sphere of clinical research occupied as it rightly is with pushing out the frontiers of knowledge concerning states of health and disease and applying scientific discoveries and technological developments as they arise to problems that have hitherto appeared to be intractable. Combined onslaught by electron microscope, isotope labelling, meticulous metabolic studies, and histo-immunological investigations, for example, has resulted in some problems slowly giving up their secrets and the leads thus given to treatment and prevention of disease have been quickly seized. This type of approach, however, does not seem appropriate—at least at the moment—to many conditions which are amenable to medical or surgical treatment and where the present problems lie not in the clinical management of the individual patient but in the provision of the necessary hospital resources.

A variation in method of treatment, in management or in the place in which it is carried out may result in substantial savings in terms of hospital resources. In realistic terms the saving is represented by the freeing of facilities, hospital beds, operating theatres, medical and nursing time for the use of other patients, thus making some inroads into the problem of provision of services. From the point of view of the patient it is a reasonable assumption that he or she will prefer to spend as short a time as possible in hospital or even better have the treatment as an out-patient if the end results are as good.

When comparing ways of providing treatment there is sometimes a tendency to assume that if a patient can be treated (*a*) at home or (*b*) in out-patients, then this will necessarily be cheaper than treatment as an in-patient and all that needs to be shown is that the alternative or innovative method of care at home or in out-patients is, in a clinical sense, as good as or better than traditional admission to hospital. Obviously this is an over-simplification of the situation. There must be a stage at which treatment at home becomes distinctly uneconomic —for instance in the case of acute respiratory failure requiring all the accoutrements of the intensive therapy unit. Similarly if a procedure is carried out in the out-patients' department but requires daily visits over a long period of time the saving in terms of an unused hospital bed begins to be balanced or unbalanced by other factors such as the need for increased out-patient department facilities and the time spent by patients in travelling for a series of appointments. Furthermore it is necessary to consider the extra work falling on local authority and GP services and the cost to them. More elegant methods of costing taking these points into account are being developed (List no. 155).

Two conditions have been the subjects of special study as part of the Department's programme of medical research because they are big users of hospital resources and because the opportunities of innovation in their management presented themselves.

In 1965 patients with hernia and varicose veins were between them responsible for 116,628 + 51,805 admissions and for (116,628 × 11·3) + (51,805 × 12·0) which equals nearly 2 million bed days (1).

Hernia

Heasman (2) pointed out that the 1960 *HIPE* tables showed that there were roughly 67,000 admissions to NHS hospitals for inguinal hernia repair without mention of obstruction. The 6,499 whose records were actually available from the one-in-ten sampling procedure demonstrated considerable variation in the length of time patients were retained in hospital post-operatively. Sixty per cent of the sample were discharged at some point during the second week after admission, while a small group, 18 per cent, went home between the fourth and seventh day.

Heasman observed that controlled trials were necessary to show whether there was any difference in the clinical results if patients stayed in hospital only a very short while after surgery. The controlled study carried out in Sheffield by Morris, Ward, and Handyside (3) compared male patients who stayed in hospital six days post-operatively with a similar group discharged one day after surgery. They observed a number of factors such as post-operative wound and chest infection, recurrence of hernia at one-year follow-up, and duration of convalescence. Only 2 patients out of a total of 92 in the short-stay group had to be readmitted—1 because of pain and one because of thrombophlebitis. In both groups there were men who developed post-operative chest infections (9 in the short-stay group of 92 and 7 out of the 94 in the longer-stay group). Patients with severe respiratory disease were excluded from the study but of the 16 patients who had a chronic productive cough pre-operatively 5 went on to develop a post-operative chest infection. As the authors point out, whether such patients (with post-operative chest infections) are best treated at home or in hospital during their illness is another question: 'if the latter is preferable there would be some value in extending the short stay period to 48 hours'. Co-operation of patients and GPs and exclusion of those with adverse medical and social backgrounds was regarded as being important in the success of any early discharge scheme. The study itself showed that early discharge was not detrimental to post-operative progress and did not produce any increase in the work-load of GPs which had not been foreseen and accepted.

Varicose veins

A 'length-of-stay' study similar to that described above could equally well be applied to surgery for varicose veins, since the variation in length of stay between regions or even between surgeons operating in the same hospital shows that there are substantial differences. However, another approach to treatment of varicose veins has been described in detail by Fegan (4). Sclerosing fluid is injected into the vein, compression bandaging is applied to maintain the occlusion of the vein and to encourage the conversion of this to a fibrous cord-like length of scar tissue. This procedure can be performed in out-patient departments. Patients may have to be seen several times to ensure

that all the veins have been dealt with; in the meantime, as well as wearing bandages, they are advised to walk at least three miles a day.

The subject of varicose veins encouraged study from several aspects: were the clinical results of injection compression sclerotherapy comparable with surgery? What was the difference in cost between the two methods? Was the time away from work influenced by the method of treatment used? The last question is of particular interest to the Department since it combines health and social security considerations.

In order to answer the first question a controlled randomized treatment trial was necessary in which the outcome in a group treated with injection/compression could be compared with the outcome of surgery in a similar group. Two trials were carried out, one at St Mary's Hospital, London (Professor Irvine and Mr John Hobbs) and one at Cardiff Royal Infirmary (Professor P. Forrest and Mr H. O. Jones). Dr Jean Weddell, then of the MRC Epidemiological Research Unit, South Wales, carried out an assessment of results of treatment and also studied the questions of cost and time away from work for the Cardiff patients (List no. 24). The clinical results referred to in this paper are those from the Cardiff study. Objective criteria for classification into cured, better, and failures had to be laid down so that they could be strictly applied by the observers carrying out the assessment in order to obtain reproducible and comparable results. The results of surgery and injection/compression therapy at one year are shown in Table 1. The results may appear rather disappointing for both methods of treatment but varicose veins are a chronic and

Table 1. Varicose veins surgical trial. One-year follow-up. Legs treated. Results

	Cured	*Better*	*Failure*	*Total*	*Not seen at one year*
MALES					
Surgery	9	18	4	31	0
Injection	8	12	6	26	0
Total	17	30	10	57	0
FEMALES					
Surgery	16	76	15	107	1
Injection	15	82	23	120	0
Total	31	158	38	227	1

Males both legs: $X^2 = 1{\cdot}19$. D.F. = 2. $0{\cdot}5 < P < 0{\cdot}7$
Females both legs: $X^2 = 1{\cdot}20$. D.F. = 2. $0{\cdot}5 < P < 0{\cdot}7$

degenerative disorder and perfect results are unlikely unless the presenting condition is mild. It is probably fair to claim that those patients classified as 'cured' and 'better' are therapeutic successes. Table 1 shows that the results of treatment by surgery and by injection are comparable.

Cost. A way of costing hospital in-patient treatment has been to combine average hospital costs with average length of stay. This method, when applied to varicose vein patients admitted to hospitals of over 100 beds, produced figures ranging from between £59 for Newcastle and £90 for Wales (using the average length of a spell in hospital for a varicose vein patient in these two regions and the 1968 costing returns). This crude method does not include any visits to the out-patient department and also conceals the fact that some in-patients require relatively little of a hospital's resources and others much more. As the operating theatre costs will be the same in short- or long-stay varicose vein patients, the extra days in hospital are a charge on its hotel services and on nursing care. Costing in relation to nursing dependency is being studied (List no. 155) but at the moment the costing returns still have to be used. In the Welsh study patients treated by surgery stayed in hospital only 4·0 days (compared with a national average of 11·7 days in 1966). The cost of treatment by surgery for a patient in the trial is estimated to have reached a total of about £35 (based on a stay of 4 days). Because a special clinic was set up to deal with the out-patient side of the work—that is treatment by injection/compression—it was possible to cost this separately. The average cost for out-patient treatment (7 visits) was £9·01, including drugs, salaries of all staff, cleaning, maintenance, and heating. The amount of time spent by medical staff over both types of treatment is approximately the same but pressure on operating theatres and beds is considerably eased. This last point was well illustrated in the St Mary's study which began not with the randomized study but by the treatment of all varicose vein patients by injection/compression—a situation which in one year eliminated the waiting list for all types of patients for the surgical unit (Hobbs, personal communication).

Duration of time away from work. Dr Weddell studied this from three points: time away before treatment, during treatment, and after

treatment. The results are summarized in Table 2 and it is at once noticeable that the number of days off work during treatment is very significantly less for the injection/compression group than for that receiving surgery, an average of 6 days compared with 29. Time off work before and after treatment was little different in the two groups. Perhaps time away from work associated with treatment by surgery is dictated more by tradition than by clinical necessity but whatever the reason the inference is clear: that operation and admission to hospital are associated with a longer period away from work than treatment by injection/compression sclerotherapy.

Table 2. Varicose vein study. Patients in full-time employment. Days away from work

	Surgery	*Injection/compression*
Number of patients	35	38
Total number of days off work		
(*a*) Before treatment	11	28
(*b*) During treatment	1,037	235
(*c*) After treatment	35	21
Average number of days off work per patient treated		
(*a*) Before treatment	0·3	0·7
(*b*) During treatment	29·6	6·2
(*c*) After treatment	1·0	0·6

One patient was excluded from the surgery group and one from the injection/compression group. The former took 60 days off before, 90 during, and 100+ after treatment. The latter took 'months and months' off before treatment, none during, and none after.

Patient preferences. Weddell (to be published) points out that the majority of patients would have preferred the injection/compression technique and that the surgeons were affected by this enthusiasm to the extent that the results had to be judged by an independent unbiased observer. Hobbs (5) also discussed patient preferences. In the St Mary's Hospital study a questionnaire was sent to all patients after completion of treatment and 90 per cent were returned. Of the patients treated surgically 47 per cent said they would have preferred treatment by injection/compression. Of the group treated by injection/compression 95 per cent still preferred this treatment and did not want surgery if their veins recurred. More women than men require treatment and out-patient techniques may be preferred because they are less disrupting to the household. Similarly 31 out of

38 men and women in full-time employment took no time off work for treatment by injection.

CONCLUSIONS

The results of treatment at two years are not yet available but on present evidence there are reasonable grounds for thinking that injection/compression sclerotherapy at £9 is good value for money compared with surgery at £35.

There is obviously little point in mounting elaborate studies to discover whether it is possible to shave a few pounds off the cost of treating something which is very expensive and/or rare. On the other hand work of the type described can have a visible effect on hospital services at local level. There is already plenty of evidence that post-operative stay in hospital for many conditions, not just hernia, is shortening and in-patient treatment for varicose veins is slightly on the downturn. The pressure of long waiting-lists may be the stimulus for change; but the existence of controlled studies provides a firm basis for it.

REFERENCES

1. *Hospital Inpatient Enquiry* (1965). Tables 3 and 6A (HMSO).
2. HEASMAN, M.A. (1964). 'How long in hospital?', *Lancet*, **ii**, 539–41.
3. MORRIS, D., WARD, A., and HANDYSIDE, A.J. (1968). 'Early discharge after hernia repair', ibid. **ii**, 681–5.
4. FEGAN, W.G. (1963). 'Continuous compression technique of injecting varicose veins', ibid. **ii**, 109–12.
5. HOBBS, J.T. (1968). 'Treatment of varicose veins: random trial of injection/compression therapy versus surgery', *Br. J. Surg.* 777–80.

13. Clinical toxicology

R. GOULDING

To judge by the current offerings of the mass media, poisoning today has lost neither its impact nor its sensationalism. At the present time, though, the preoccupation is with the toxic contamination of the environment and how the community may be pervasively at risk from food additives, chemical residues from agriculture, and the air we breathe. Homicide by arsenic, strychnine, and the like has virtually been relegated to history.

Acute poisoning has, nevertheless, by no means disappeared entirely. In England and Wales the total number of deaths each year may be slightly decreasing, but the figure is still in excess of 5,000. As a cause of mortality, acute poisoning is not high on the Registrar-General's list. By contrast, the extent of non-fatal poisoning is enormous. An indication of this is afforded by the *Hospital In-Patient Enquiry*. The total number of discharges and deaths under this diagnostic heading for England and Wales has risen from about 16,000 in 1957 to no less than 67,000 in 1967. In some medical units poisoning tops the list of emergency admissions. Official attention was given to this problem by a subcommittee of the Standing Medical Advisory Committee, the report of which, under the title of *Emergency Treatment in Hospital of Cases of Acute Poisoning*, appeared in 1962. The observation was made that, 'the number of poisonous preparations on the market is growing so rapidly that although they are issued in various forms and colours, their recognition is becoming increasingly difficult'. Accordingly a formal recommendation was made that 'an information service on poisoning should be set up with

central arrangements for co-ordination'. No time was lost in implementing this proposal and in September 1963 the National Poisons Information Service came into operation. This, with its principal originating and co-ordinating focus at Guy's Hospital, had associated centres in Edinburgh, Cardiff, and Belfast (Dublin was included in 1965). By this means any doctor, whether in general practice, hospital, or elsewhere, faced with a patient either overtly poisoned, or suspected of so being, was enabled to telephone at any hour of the day or night to ascertain the toxic nature of the agent believed to be responsible, together with guidance on management. Beginning with about 2,000 inquiries in the first year of operation the over-all demand on the service rose to more than 15,000 calls in 1970.

This same subcommittee suggested that 'one general hospital in an area should be designated as the preferred receiving centre for cases of poisoning. . . . It should have an adequate laboratory service.' In addition the plea was made that it was 'desirable to have a centre for academic research in toxicology'. While the information sought from the information service over the years has been, in the main, clinical, an increasing number of queries has been directed at laboratory aspects. The detection and estimation of toxic substances in body fluids have hitherto been largely a forensic exercise. Hospital departments of clinical pathology, with much of their emphasis on a rapidly increasing work-load and a corresponding application of automation, have had less opportunity to develop the often specialized techniques of toxicological analysis. As a question of policy, therefore, thought had to be given to the feasibility of upgrading hospital laboratories generally in this respect, as against encouraging central research and development in the first instance. Acting on the second alternative, such a laboratory was first set up at the instance of the (then) Ministry of Health in February 1967, the initial capital and subsequent revenue funds being advanced from the moneys allocated for 'special developments'. For the sake of administrative convenience, this laboratory functions as a department of Guy's Hospital, though geographically it is situated at New Cross Hospital, Avonley Road, SE 14 (part of the Guy's group), while its obligations extend to any other hospital or doctor in the NHS wishing to take advantage of them.

Responsibility for this unit has been entrusted to the Director of the Information Service already in post. In the beginning he was

assisted by a staff of a senior biochemist, two other graduate biochemists, and five technicians, guidance on over-all policy being provided by a steering group representing the interests not only of Guy's, but of King's College Hospital as well, along with the South-east Metropolitan Regional Board, the MRC Toxicological Research Unit at Carshalton, and the Department of Health. Accommodation in the first place was limited, but instrumentation was generous and comprehensive. More recently—in fact in July 1970—this initial laboratory was extended by a purpose-designed building incorporating more advanced facilities. These include an animal house, an isotope room, and provision for cold-room working, besides more general bench space and a library meeting room. The staff complement, too, has now expanded to include a medical registrar for liaison with the clinical departments and intensive-care ward at Guy's: in addition six non-medical graduates, twelve technicians, and associated support. Over the relatively brief period of four years since this laboratory first came into being its work has undergone substantial revision.

At the outset an assumption was made, somewhat erroneously as it turned out, that the primary task would be to search and index the literature for suitable analytical procedures, to check these for their suitability and then to offer their performance as a service to anyone in the NHS so desiring. In the event it soon became apparent that for the majority of drugs and poisons there is no established set of methods for this purpose that are specific, sensitive, reliable, and practicable. This stricture applies mortifyingly not only to the traditional substances that were introduced to use before chemical analysis had reached its present-day advances but also to many of the new drugs at present coming on the market. Before, therefore, any overtures could be made to assist others it became imperative to concentrate the utmost energy on what has been called methodological research. Clearly the territory offering itself for this sort of analytical exploration had every appearance of being boundless. So, bearing in mind that poisonings and their hospital management in this country are largely a matter of drug overdosage, the main groups of so-called psychotropic drugs were selected for study. The techniques in use have included thin-layer chromatography, ultra-violet spectrophotometry, infra-red spectrophotometry, gas-liquid chromatography, spectrophotofluorimetry, polarography, and atomic absorption.

Analytical methods applicable to blood, urine, and other biological specimens have been originated, developed, or refined for barbiturates, certain other non-barbiturate hypnotics, notably methaqualone, drugs of the amphetamine-like group including fenfluramine, the tricyclic antidepressants which are now enjoying such popularity in psychiatric practice, some of the benzodiazapines, e.g. diazepam (valium), as well as chloral hydrate and its associated compounds, alcohol, bromides, paracetamol, and some of the heavy metals. In addition, some of the work is proceeding with drugs of dependence in blood and urine and a special interest has been taken in the weed-killer, paraquat, which has been the cause, when erroneously swallowed, of some devastating cases of poisoning in man. One object is to compile a manual of methods, which have been checked and confirmed, so that these can be followed and adapted so far as possible in departments of chemical pathology in other hospitals. This task, which will never reach completion, is now well advanced. Already in this connection considerable assistance has been given to a joint committee of the Association of Clinical Biochemists and the Association of Clinical Pathologists in drawing-up a revised version of the broadsheet designed for hospital biochemists and pathologists on poisons detection in biological specimens.

Quite apart, however, from these essentially procedural aspects, which have consumed much time and effort, there remains the need to interpret the findings. What, in fact, is the meaning of any given blood level or extent of urinary excretion? Here, again, there is a dearth of documented and, above all, critically quantitative evidence on which to base any deductions. So little is known about what is now termed the 'pharmacokinetics' of so many of the drugs widely used therapeutically and so frequently misused toxicologically. This means that careful and sequential assays must be carried out, primarily on blood and urine, first following recognized dosage and then of over-dosage, and correlating the results with the clinical responses of the patient.

Careful and continuing observations are made on patients and volunteers and matched with the laboratory results. In this way it is becoming practicable to reinforce the clinical impressions with quantitative findings and, moreover, to arrive at a more reliable prognosis so that management can be deployed effectively and with more assurance—at times to the extent of sparing the patient from superfluous

intervention. In short, clinical toxicology has been revealed for what it in fact is, an extension of clinical pharmacology.

This fascination with research has not obtruded entirely to the exclusion of service commitments. In a recent period of eighteen months some thousand cases of poisoning have been referred for laboratory assistance, each incident demanding usually more than one analysis. Over the same period more than six hundred urine specimens have been screened for drugs of dependence. Naturally most of these requests have come from the London area, but assistance has also been sought from as far away, for instance, as Exeter, Llandudno, Norwich, Birmingham, and Leeds.

What still has to be settled is precisely how such a venture as this should be equated with the rest of the hospital service. Argument proceeds about the ideal size and distribution of hospital departments of chemical pathology. There is obviously a limit to be set to the degree of centralization and gigantism that should be encouraged, consistent with efficiency, promptness, and maintenance of informative communication. Judged nevertheless by the criteria of research it is probably reasonable to accept, at least at the present juncture, that there is merit in having only a few of these specialist toxicological centres. Their original discoveries can be transmitted easily enough to the rest of the country and their educational activities can be successfully promoted as well by attracting other hospital laboratory workers to lectures, demonstrations, and 'workshops', all of which are being developed at New Cross. Short periods of assignment can also be arranged for selected trainees not only from the UK but also from Europe and further afield as well. For the day-to-day service the feeling remains that decentralization should be encouraged. While the telephoning of results entails very little time-lag, the mobilizing of transport for specimens raises difficulties not yet always solved—despite the enthusiasm, on occasion, of the police to assist. The realization, nevertheless, remains that toxicological analysis can no longer be carried out usefully with the simple apparatus of the past. Advanced, intricate, elaborate, and above all costly equipment is indispensable. The capital outlay is formidable. In terms of economics this demands expert handling and intense utilization, an argument in itself against proliferation. Moreover, in any budgeting for this sort of installation the impact of capital depreciation and consequent cost of replacement should not be disregarded.

There are those who contend, first, that in the realm of medicine the claims of poisoning must be relegated in the priorities league to well behind more pressing demands and, second, that anyway poisoned patients can easily be treated without recourse to ancillary laboratory tests. This perhaps savours of a complacency of which there are examples throughout medical history. Given the opportunity to study more scientifically the implications of poisoning in Britain then the rewards, admittedly, may not always be gratifying to toxicology alone but may prove invaluable elsewhere, not least to the practice of more effective and, at once, less dangerous therapeutics.

14. Regular haemodialysis and renal transplantation

CATHERINE N. DENNIS

The NHS is bound to provide modern care for patients and, if they are to benefit and medicine is to progress, developments must be allowed for and facilities provided. Usually the introduction of any new hospital service has to take its place in the queue for priorities for which the regional hospital boards and boards of governors are responsible. This has led occasionally in the past to an uneven distribution of services or to an over-provision (and under-use) of expensive highly technical facilities. An example of this is cardiac surgery with its large staff requirements, where in the metropolitan regions alone nearly twenty centres carry out heart operations using bypass techniques and where expensive cardiological investigatory laboratories have been set up. Many of these units do not carry out a large enough total number of operations to obtain the best results or the optimum use of staff and equipment.

Regular haemodialysis and renal transplantation for terminal chronic renal failure are examples of highly specialized medical techniques which create substantial demands both in terms of money and manpower; for example the average capital cost of a ten-bed regular dialysis unit is £110,000 and the running cost between £65,000 and £70,000 per annum; the staff required includes consultant physicians (eight sessions), surgeons (two sessions), other supporting medical staff, ten trained nurses, and technical and ancillary staff.

In the development of regular haemodialysis and renal transplantation the Department took the unusual step of directly promoting these services, with the advice of two special medical committees. The

aim was to provide as rapidly as possible a basic framework upon which the services could be efficiently and economically built. Regular haemodialysis developed several years in advance of renal transplantation but the two have now reached the stage of being complementary rather than rival forms of treatment.

In 1964 a few groups of workers in this country began to confirm pioneer work in America that patients who were suffering from end-stage renal failure could be rehabilitated and return to work if treated by twice-weekly regular haemodialysis. Intense pressure to provide this life-saving measure built up. In the following year a special medical conference under Lord Rosenheim advised the Department that regular haemodialysis was an established and effective form of treatment which should be developed in this country as rapidly as was compatible with proper training of staff and a high standard of patient care.

Money was reserved from the total allocation normally distributed to hospital boards to introduce this new service. A working party of experts under Professor de Wardener was called together to advise the Department. This recommended that between ten and twenty main centres should be set up in England and Wales each having some ten beds. Boards were asked to prepare plans for one or possibly two centres in each region and submit these to the Department.

It was appreciated from the outset that these initial centres could not meet the expected demand for treatment and maintenance (a tentative figure of thirty new patients per million population per year was taken for planning purposes). However, they would serve as a basis from which to expand. They would act as an initial training ground for all grades of staff and would be the foci for research in addition to treating patients. It was soon recognized that regular dialysis formed but a part of the total care of the renal failure patient and it was recommended that main centres should form part of nephrology units where the full range of renal medicine was practised. Research into equipment was also fostered. A list of current activities under this head is given in Part III (see Subject Index: renal disease). It will be noted that agents outside the NHS such as the Atomic Weapons Research Establishment, the Atomic Energy Research Establishment, and university departments have collaborated in the various equipment research projects both for dialysis and renal transplantation.

Home dialysis became a possibility with the development of the single-patient machine with built-in fail-safe mechanisms. After a few patients had been treated at home successfully, the working party advised that this was the method of choice for increasing the number of patients who could be offered treatment. Most main centres are expanding their patient numbers by this means. On 30 June 1970 the number of regular dialysis units in England and Wales was 31, the number of hospital patients was 453, and the number of patients on home dialysis was 441.

Now that a nationwide network has been established and facilities provided in every hospital region the Department has asked the hospital boards to continue the service under normal arrangements.

Renal transplantation presented fundamental problems chiefly of an immunological nature. In the early pioneer days all too often technically excellent surgical operations ended in disaster with overwhelming infection or kidney rejection. It was apparent that basic research was the primary need. Much of this was carried out under the auspices of the MRC with the hospital service providing support for patient care.

Progress in the renal transplant field was kept under review by the MRC and by 1967, the results of kidney transplants as judged by survivals for a year or more were promising (Kidney Transplant Registry, Boston) chiefly owing to improved methods of immunosuppression. In July of that year the Department was advised by the MRC that, because of recent advances, cautious and controlled extension should be considered. The Department, together with the Scottish Home and Health Department, set up a Joint Advisory Committee (ACRT) under Sir Hedley Atkins and is conducting a similar exercise, though on a more limited scale, to that described for regular haemodialysis. At present there are twelve renal transplant units in England and Wales receiving central support and 164 transplants were carried out in these centres in 1969.

Though graft survival has improved with new methods of immunosuppression there are still failures. Back in 1946 Medawar's now classic work revealed that leucocytes carried transplant antigens but only recently has it become accepted generally that matching of donor and recipient tissues through leucocyte grouping may enhance graft survival. In 1968 the MRC set up a one-year pilot trial led by Professor Batchelor at East Grinstead and involving four transplant

units to ascertain whether a tissue typing scheme was feasible. From the research laboratories at East Grinstead microquantities of material for typing and other reagents were prepared and distributed to the centres who undertook the tissue typing of recipients and donors. It was apparent before the end of the trial period that the Department needed to set up a National Tissue Typing Reference Laboratory. This was established at the Bristol Blood Transfusion Unit under its Director, Dr G. H. Tovey, in 1969. This laboratory collaborates with others and with the renal transplant units.

Though the results of transplantation using kidneys donated by relatives are superior to those using cadaver kidneys, in this country as in most others cadaver kidney transplants are much more frequently carried out. The numbers of kidneys that are offered to the transplant units fall short of the need, but the Health Departments with advice from the ACRT are setting up a National Organ Matching and Distribution Service associated with the National Tissue Typing Reference Laboratory at Bristol in an endeavour to make the best use of available donor kidneys.

Whilst regular dialysis and renal transplantation offer life to patients with terminal renal failure a particularly difficult problem has arisen in these units and that is the hazard of viral hepatitis. Patients may develop frank hepatitis, have a sub-clinical attack or have no signs of clinical infection, yet they may become chronic carriers as judged by circulating hepatitis-associated (Australia) antigen. This presents risks to the other patients and to staff in the units, together with others treating patients or handling infective material.

Several groups are studying various aspects of the problem, for example microbiological aspects of haemodialysis, health hazards in hospital laboratories, disinfection of linen, and protection of laundry workers.

An advisory committee on testing for the presence of Australia antigen and its antibody, chaired by Dr W. d'A. Maycock, has as one of its tasks a review of the organization and responsibility for testing donated and other specimens of blood. The Hepatitis Advisory Group chaired by Lord Rosenheim is reviewing the medical problems arising in the treatment of chronic renal failure by means of intermittent dialysis and renal transplantation with particular emphasis on hepatitis.

In addition research into hepatitis is being supported by various agencies—including the MRC.

It will be appreciated that a large investment has been made in the lifesaving treatment of end-stage renal failure but it is worth noting also that a substantial drive is being directed towards one aspect of prevention (see pp. 52–3). Ultimately, this may pay dividends but the problem of terminal renal failure will remain for the foreseeable future.

REFERENCE

Kidney Transplant Register—Boston, 6th and 7th Reports.

15. Oxford Record Linkage Study

J. M. G. WILSON

In his book *Medical Record Linkage*, Acheson (1) opens with a quotation from Dunn (1946) as follows: 'Each person in the world creates a book of life. This book starts with birth and ends with death. Its pages are made up of the records of the principal events in life. Record linkage is the name given to the process of assembling the pages of this book into a volume.' Although within the NHS there is the potential for the cumulative association of patients' medical histories, and even of linking these histories within families and from one generation to the next, medical records in England and Wales are still much in the form that has developed according to need since gentleman clerks walked the hospital wards of their chief and wrote up the notes of their patients. Similarly, in general practice the form of patient notes is basically the same as that which was developed with the Lloyd George National Insurance Act of 1911. In their present form medical and vital records provide a mass of information about individuals the total value of which in patient care and research is likely to be much greater than the sum of the parts. An important question is whether the additional cost of linking records is justified by the added benefits.

Though *ad hoc* linkage had, for many years, been carried out in England and Wales for the purposes of research, it was only when a letter in the *British Medical Journal* by Acheson. Truelove, and Witts (2) sparked off widespread interest in the topic that a practical step towards medical record linkage was taken by starting the Oxford Record Linkage Study (ORLS).

The Study began in 1961 with a grant from the Nuffield Foundation. Support was continued in 1965 by the Ministry of Health while at the same time the Nuffield Provincial Hospitals Trust made a grant for starting the Unit of Clinical Epidemiology to exploit the material provided by record linkage. From the beginning the Study was accepted by the University of Oxford as within its administrative structure and the Director is a member of the Department of the Regius Professor of Medicine.

The aims of the Study (the first linked data from which starts in 1963) are as follows:

1. To study the feasibility and cost of abstracting information concerning important health events for all members of a defined population, and of organizing cumulative personal and family files;[1]

2. To develop computer methods of recordi linkage;

3. To study the applications of the linked data to medical and operational research;

4. If experience with the local Study is favourable, to promote a system of linked medical records on a national scale.

Progress has been made on most of these fronts. Information on all births, deaths, obstetric deliveries (both at home and hospital), and hospital discharges has been associated on individual cumulative files, first for the population of Oxford and Oxfordshire (340,000), later extending to Reading and much of Berkshire (an increase of 735,000), and, recently, moving to embrace the whole of the Oxford Regional Hospital Board area, a population of 1·7 million.

Some of the main factors in abstracting the maximum research and service benefit from record linkage are the size of the population and the area covered, and the extent to which records are linked or linkable. Thus the extension of existing record linkage to the whole population of the Oxford hospital region will not only allow the system to be used for providing Hospital Activity Analysis data for monitoring and planning purposes but will also provide large enough numbers of records to enable the less common medical and surgical

1. It is important to note that within the ORLS cumulative personal files exist only when actually assembled for particular purposes by the Study, through the association of punched cards or magnetic tape data; cumulative personal records of patients do not exist in physical form in the hospitals or the general practices which take part in the Study.

conditions to be studied usefully. Even regional linking facilities will not provide adequately for family and genetic studies because of the losses to the system from emigration to non-linked areas. Following a suggestion put forward by the MRC, a departmental working party was set up to study the feasibility and cost of a national record linkage system. Record linkage is essentially a tool for research and service purposes but it has great potential value in health care for the individual through his lifetime.

The serious problem of linking and storing data on the computer has largely been overcome—one of the chief difficulties has been the computer identification of individuals, the *sine qua non* of record linking. Even given the successful solution of linkage problems the major questions of secure confidentiality and public confidence remain. This aspect of record linkage is of the first importance, and one that has remained in the forefront of the thinking of those concerned. Rigid precautions are taken which make it impossible for unauthorized persons to gain access to the stored data. The data are stored in a 'scrambled' form and the 'keys' needed to unscramble them are held only by authorized medical staff; even the technical staff of the project are unable to gain access. The information obtained by the Study is all of a medical nature, consisting of births, deaths, in-patient admissions to acute and maternity hospital, and domiciliary obstetric data. There are two ways of using this linked information—statistical and personal. The ORLS publishes only statistical data, that is information accumulated on numbers of patients and without personal identification. Information on individual patients, for example linking a number of medical events in the same patient, is passed only to the doctors havingt he medical care of these patients or, with additional precautions described in the next sentence, for *bona fide* medical research purposes, e.g. the follow-up of a group of patients over time. In this second instance information about an individual patient is only passed to another doctor with the consent of the doctor having that patient's care. The issue of confidentiality and the possibility of its breach need continuing attention; the subject was dealt with in some detail in Acheson's book *Medical Record Linkage* (1) and at the International Symposium on Record Linkage in Medicine held at Oxford where a session was devoted to the subject (3).

It is the third item of the ORLS's aims, the application of record linkage to medical and 'operational' research, and its use in providing guides for improving clinical management, that most concerns us here, and which must provide the justification for the continuation and expansion of record linkage. The Unit of Clinical Epidemiology was formed for this specific purpose—to mine and exploit the linked data in addition to developing linkage systems. How successful has this been? This is not the place to discuss in detail all the research carried out, and routine medical information prepared, using ORLS data—the references list much detailed work. However, it is worthwhile considering briefly some examples as illustrating the uses of linkage.

Use has been made of linked records in a number of ways in improving the quality of the information needed for evaluating the results of medical care, and for planning purposes. It is possible here to examine only a few of the uses that can be made of linked medical records. For example, linkage makes possible the assembly of hospital spells into lists of persons discharged, and a diagnostic index based on persons rather than discharges can readily be constructed. In addition, by linking deaths, hospital medical staff can be provided with true fatality rates for different conditions, rather than having to rely on informal information about the subsequent death of their patients. Acheson (4) has shown that 40 per cent of deaths which had occurred within one calendar year of discharge elsewhere than in the hospital from which the patient had been treated were unknown to the hospital. Other examples of routine data provided through linkage are: the provision of lists of patients with specific diseases to those concerned in their care, for example, lists of discharges and deaths from cancer of the cervix to the pathologist in charge of the cytology laboratory, which enable the removal of names from lists of women for recall for future examinations where this would be inappropriate; the provision of diagnostic and operation indexes for hospitals which facilitate the follow-up of patients with specific conditions as well as providing lists of patients' records for research purposes; the provision of 'at risk' registers to medical officers of health giving information about low birth-weight, congenital malformations, rhesus disease, history of foetal distress, antepartum haemorrhage, or maternal resuscitation during labour. While the concept of a limited 'at risk' register from which only certain

children are kept under surveillance may be questioned, there is a clear advantage in providing health visitors, through the medical officer of health, with lists of children in whom there is either some recognized abnormality at or near birth, or else some major risk to the future health and development of the child.

Linking events occurring at relatively long intervals of time can provide powerful means of investigating disease. For example, had personal cumulative records existed, the relationship between occupation in the rubber and electric cable industries, which use anti-oxidants such as beta-naphthylamine, and bladder cancer might have been demonstrated earlier. If the prescription of drugs were linked through general practice records, the relationship between thalidomide and congenital malformation might have become apparent sooner.

A specific study of perinatal mortality and the organization of hospital services in the Oxford area demonstrates clearly how the simple linkage of hospital and domiciliary data on births in relation to the place of birth can provide useful information for planning obstetric services. Hobbs and Acheson (5) studied nearly 6,000 primiparous births for which 60 per cent of the mothers had been booked for consultant care while 40 per cent had been booked for either home delivery or admission to a GP maternity unit. Whilst expectant mothers in the highest of the three defined risk groups were mostly booked for consultant care, the perinatal mortality in both consultant and GP booked cases was the same—19 and 20 per 1,000 births. In view of the fact that risk factors such as lower social class, higher maternal age, low previous birth-weight, and past history of miscarriage predominated in the consultant care group of mothers, the inference is drawn that a perinatal mortality of the GP-booked cases only equal to that of the hospital consultant obstetric group of mothers is unsatisfactory; since the risk factors in the GP group were fewer, perinatal mortality experience should have been appreciably better.

The greater probability of an unfavourable outcome of pregnancy in the GP-booked women was borne out by a high rate of emergency transfer to consultant care. The authors thus conclude that where possible births to multiparous women should take place in fully equipped obstetric units. This finding fits well with the present trend to combine GP and consultant obstetric care in one hospital-based

unit, nowadays a district general hospital. Another study (6) gave further information useful for planning. The authors showed that where there was no convenient GP maternity unit, expectant mothers with high-risk factors were ready to travel considerable distances for care in fully equipped consultant obstetric units; while, where a GP maternity unit was near at hand, the proportion of cases booked for fully equipped hospital obstetric units fell off sharply with distance. It seems that where GP maternity units are provided, they are best sited in association with consultant obstetric units since the prognosis for the high-risk mother is better when full facilities are provided even though she has to travel further to reach them. Without the link between domiciliary and hospital deliveries, and the facility for comparing one hospital's performance with another, information of this kind could not have been obtained, except through an *ad hoc* study, which itself would be facilitated by linkage.

Another study of importance in planning for services as well as in contributing to knowledge where hitherto we have been ignorant is that carried out by Kinlen (1969) on the incidence and natural history of acute myocardial infarction in the Oxford area (see pp. 125–6). This study was based on record linkage in that the data provided information on all patient admissions to hospital and all deaths; it did not give information about patients looked after at home apart from those who died. For this group a special notification scheme was instituted.

A number of other studies have been carried out using the linked data both by Acheson and his colleagues of the Unit of Clinical Epidemiology and by outside research workers. A list of these studies is appended.

We have seen that the existing record linkage system has been broadened to include in the near future the entire hospital region; and that the Study has been instrumental in leading to the examination of the merits of national record linkage. However, the original sights set for linkage were limited on the grounds of ensuring the successful establishment of the Study, as well as for economic reasons. Only births, deaths, hospital in-patient discharges, and obstetric deliveries at home and in hospitals or nursing homes were included. Two obvious areas for extension, apart from the less-immediate possibilities of including such records as those of school health, are hospital out-patients and general practice. So far, partly because of the

immensely larger number of records with the consequent high cost of providing these in processable form and partly because of the imprecision of much out-patient data, no attempt has been made to link these records at Oxford, though specialized examples exist elsewhere, for example in the north-east Scotland psychiatric register. In the field of general practice, however, a useful start has been made and considerable enthusiasm has been met with among family doctors. A group general practice in Bicester has formed the locus of a study of transferring the records of day-to-day transactions on to computer compatible punch cards (7, 8, 9). The basic move was to record the personal data of all patients, their place of residence, and their migrations into and out of the practice by birth, death, and removal. This in itself provided useful information on the geographical scatter of the practice, on the turnover of patients (60 per cent of new registrations had occurred between 1961 and 1967), and the rate of removal from the practice (which was about 10 per cent per annum). In addition, studies of the demand for urgent treatment and methods of locating and keeping under surveillance special risk groups of the practice, such as the elderly and the obese, have been made. As a result of these preliminary studies (as far as record linkage is concerned) considerable interest has been aroused among other general practices in the region and the stage is set for the next step, the conversion of general practice records into processable cumulative personal records so that linkage of these with other morbidity data, including family file data, can be carried out, with the aim of providing the family doctor with better information for patient care.

Since July 1969 the Study has been directed by Dr J. A. Baldwin, with Mr L. E. Gill as computer scientist. The main effort has been focused on development of an operational system to carry out name matching and record linkage and output an updated file on the Atlas computer. This objective was attained towards the end of 1970 and research on the file of cumulative personal records covering five to seven years has begun. The main work, to be carried out by Dr A. S. Fairbairn, will centre round mortality following operation, readmission rates, and associations between diagnoses.

At the same time, extension of the Study to cover the whole region has been started with experiments in newer methods of data capture, a fresh approach to computer file structure, and re-examination of

record linkage techniques. The reasons for these developments are to produce timely and pertinent data for hospital management and planning (Hospital Activity Analysis) and clinical research, to improve the reliability of data and of linkage, and to achieve the greatest possible economy. A regional file system is being constructed, capable of meeting management needs which make the system worthwhile from the hospitals' point of view, and greatly extending the research potential by allowing for specialized data to be incorporated for particular purposes. Information relevant to psychiatry and subnormality will be brought in from 1971, the extensive maternity data which, apart from 1962 and 1963, have not been linked into the computer system, will be integrated, and eventually it should be possible to provide for a wide range of specialized data. These developments have been made possible by a grant for use of a front-end processor to a large remote computer system.

Looking a little further into the future, experiments with out-patient and extramural data collection are planned, together with steps towards standardization of some parts of the medical record, with the processable information as a byproduct. In the Oxford hospitals, a major computer project is being developed which should greatly facilitate data acquisition for the linked regional files.

The large questions now outstanding are less to do with the feasibility and cost of record linkage than with how far it is worth taking it. Should the linked or linkable system of records attempt to provide more than a sampling frame, a means of identifying groups of special interest and a monitor for management purposes? Should provision be made for highly specialized research or management projects to be integrated, indefinitely extending the data base and thus the potential uses of the retrieval system; or should the function be restricted to the minimum which could be regarded as normal hospital routine? Information systems, with or without linkage, cannot replace normal methods of research. The question is how far they can facilitate and encourage research, particularly on large patient populations and over long time-periods.

The cost of record linkage has been much discussed and firm conclusions based on the ORLS alone cannot be drawn. Perhaps the chief reason for this is that cost very much depends on the information that can be used. Everyone has an NHS number which uniquely identifies that person, but studies have shown that this number is

only recorded on about 25 per cent of medical documents when it is asked for. Instead, matching by name and other identifying data has to be used in linking records, and this adds considerably to the cost. Baldwin (1970, personal communication) puts the cost per record in the ORLS, on the computer and suitable for unlinked analyses such as Hospital Activity Analysis, at 27½p and the cost expressly of linking the records as 2½p. We must remember that the ORLS is a special study using existing records and that at the stage of development about which Acheson was writing full computer processing was not in operation. Almost certainly the cost of linkage could be very much lowered.

One difficulty about this study of record linkage must be faced. This is that for using the potentialities to the full a very wide area, and preferably the whole country, must be covered. Family and genetic studies have not so far been pursued within the ORLS and this is largely due to the continuous migration of the population. This provides one of the arguments for widening the scope of record linkage to cover the population as a whole—as is being done (with a limited extent of linkage) in Scotland and Northern Ireland. The case for national record linkage in England and Wales is at the moment under examination (as was mentioned above) within the Department.

REFERENCES

1. ACHESON, E.D. (1967). *Medical Record Linkage* (Oxford University Press for the Nuffield Provincial Hospitals Trust).
2. —— TRUELOVE, S.C., and WITTS, L.J. (1961). 'National epidemiology', *Br. med. J.* **1**, 668.
3. —— (1968). 'The Oxford Record Linkage Study—the first five years', in *The Proceedings of the International Symposium on Record Linkage in Medicine held in Oxford, July, 1967* (Edinburgh and London: E. & S. Livingstone Ltd.).
4. —— (1967). 'Morbidity Report' in *City of Oxford Annual Report of the Medical Officer of Health for the year 1966.*
5. HOBBS, M.S.T., and ACHESON, E.D. (1966*a*). 'Perinatal mortality and the organisation of obstetric services in the Oxford area in 1962', *Br. med. J.* **1**, 499.
6. —— (1966). 'Obstetric care in the first pregnancy', *Lancet*, **i**, 761.
7. FORBES, J.A., MUTCH, L.M.M., SMITH, G.T., and TULLOCH, A.J. (1967). 'Study of the demand for urgent treatment in general practice', *Br. med. J.* **3**, 856–8.

8. ACHESON, E.D., and FORBES, J.A. (1968). 'Experiment in the retrieval of information in general practice', *Br. J. prev. soc. Med.* **22,** 105–9.

9. FORBES, J.A. (1969). 'Locating the elderly in a general practice', *Br. med. J.* **2,** 46, 47.

SELECTED BIBLIOGRAPHY

ACHESON, E.D. (1964). *M.R.C. Symposium on Mathematics and Computer Science in Biology and Medicine. The Structure, Function and Cost of a File of Linked Health Data* (HMSO, 1965).

—— (1964). 'The Oxford Record Linkage Study: a central file of morbidity and mortality records for a pilot population', *Br. med. J.* **18,** 8.

—— and EVANS, J.G. (1964). 'The Oxford Record Linkage Study: a review of the method with some preliminary results', *Proc. R. Soc. Med.* **57,** 269.

—— and FELDSTEIN, M.S. (1964). 'Duration of stay in hospital for normal maternity care', *Br. med. J.* **2,** 95.

—— and BARR, A. (1965). 'Multiple spells of inpatient treatment in a calendar year', *Br. J. prev. soc. Med.* **19** (4), 182.

—— (1965). 'Hospital morbidity in early life in relation to certain maternal and foetal characteristics and events at delivery', ibid. **19** (4), 164.

—— (1966). 'Computers: (c) Medical record linkage—the method and its application', *Jl R. Soc. Hlth,* **86,** 217.

—— HADFIELD, E.H., and MACBETH, R.G. (1967). 'Carcinoma of the nasal cavity and accessory sinuses in woodworkers', *Lancet,* **i,** 311.

—— (1968) 'Medical record linkage', *Br. med. Bull.* **24,** 206.

—— (ed.) (1968). *Proceedings of the International Symposium on Record Linkage in Medicine held in Oxford, July, 1967,* Session 7 (Edinburgh and London: E. & S. Livingstone Ltd).

—— (1968). 'Record linkage techniques in studies of the aetiology of cancer', *Proc. R. Soc. Med.* **61,** 727.

—— (1968). 'Records and file organization for population screening procedures in preventive medicine', in *Presymptomatic Detection and Early Diagnosis,* Sharp, C.L., and Keen, H. (London: Pitman Medical Publishing Co. Ltd.).

—— (1968). 'Some remarks on contemporary British medical statistics', *Jl R. statist. Soc.* series A (General), **131,** part 1, 9–12.

—— COWDELL, E.H., HADFIELD, E., and MACBETH, R.G. (1968). 'Nasal cancer in woodworkers in the furniture industry', *Br. med. J.* **2,** 587–96.

—— and RANG, E. (1968). 'The clinical significance of deaths after discharge from hospital unrecorded in the hospital notes', *Lancet,* **ii,** 908.

—— (1969). 'Medical record linkage', *Methods of Information in Medicine* (January), 1–6.

—— and FAIRBAIRN, A.S. (1960). 'Burden of cerebrovascular disease in the Oxford area in 1963 and 1964', *Br. med. J.* **2,** 621–6.

ALDERSON, M.R., and MEADE, T.W. (1967). *Br. J. prev. soc. Med.* **21,** 22–9.

EVANS, J.G. (1967). 'Deliberate self-poisoning in the Oxford area', ibid. **21,** 97–107.

FAIRBAIRN, A.S. (1967). 'Diagnostic differences at successive hospital admissions'- in *The Proceedings of the International Symposium on Record Linkage in Medi, cine held in Oxford, July, 1967* (Edinburgh and London: E. & S. Livingstone Ltd).

—— and ACHESON, E.D. (1969). 'The extent of organ removal in the Oxford area', *J. chron. Dis.* **22**, 111–22.

HOBBS, M.S.T. (1967). 'A study of birthweight in sibships', in *The Proceedings of the International Symposium on Record Linkage in Medicine held in Oxford, July, 1967* (Edinburgh and London: E. & S. Livingstone Ltd).

——(1967). Foetal loss and the organization of the obstetric services', Thesis for degree of D.Phil., Oxford.

—— (1967). 'Survey of general practitioner units in England and Wales', *Br. med. J.* **4**, 287–90.

—— and ACHESON, E.D. (1966*b*). 'Secondary sex ratio following bleeding in pregnancy', *Lancet*, **i**, 462.

HUBBARD, M.R., and FISHER, J. (1967). 'A computer system for medical record linkage', in *The Proceedings of the International Symposium on Record Linkage in Medicine held in Oxford, July, 1967* (Edinburgh and London: E. & S. Livingstone Ltd).

—— and ACHESON, E.D. (1967). 'Notification of death occurring after discharge from hospital', *Br. med. J.* **3**, 612–13.

KINLEN, L.J., and ACHESON, E.D. (1968). 'Diagnostic irradiation, congenital malformations and spontaneous abortion', *Br. J. radiol.* **41**, 648–54.

MCCALL, M.G., and ACHESON, E.D. (1968). 'Frequency of multiple sclerosis in three Australian cities—Perth, Newcastle and Hobart', *J. neurol., neurosurg. and psychiat.*

—— —— (1968). 'Respiratory disease in infancy', *J. chron. Dis.* **21**, 349–59.

RANG, E.H., FAIRBAIRN, A.S., and ACHESON, E.D. (1970). 'An enquiry into the incidence and prognosis of undiagnosed abdominal pain treated in hospital', *Br. J. prev. soc. Med.* **24**, 47–51.

WATTS, S.P., and ACHESON, E.D. (1967). 'Computer method for deriving hospital inpatient morbidity statistics based on the person as the unit', *Br. med. J.* **4**, 47–7.

Oxford Record Linkage Study: a list of reports

R1. *Vital Statistics, Results 1962* (August 1962).

R2. *Multiple In-Patient Spells. Results 1962* (E. D. Acheson and A. Barr).

R3. *Lodger Patients and Elective Interward Transfers at the Radcliffe* (A. Barr and E. D. Acheson) (February 1964).

R4. *Some Comparisons between the Littlemore and Warneford Hospitals in 1962* (July 1964).

R5. *A Study of Perinatal Mortality in the Oxford Area in 1962* (M. S. T. Hobbs and E. D. Acheson) (January 1965).

R6. *Clerical Check of Computer Decisions with a Note on Proposed Modifications to the System* (E. D. Acheson and J. Fisher) (February 1965).

R7. *Hospital Morbidity in Early Life in Relating to Certain Maternal and Foetal Characteristics and Events at Delivery* (E. D. Acheson) (February 1965).

R8. *Further Studies in Perinatal Mortality: Valuation between Practices* (M. S. T. Hobbs and E. D. Acheson) (April 1965).

R9. *Vital Statistics. Results 1963* (April 1965).

R10. *Obstetric Care in the First Pregnancy* (M. S. T. Hobbs and E. D. Acheson) (January 1966).

R11. *Vital Statistics. Results 1964* (May 1967).

R12. *Vital Statistics. Results 1965* (July 1967).

R13. *The Accident Services in the Oxford and Reading Areas 1966* (July 1967).

R14*a*. *First Report to the Department of Surgery January–June 1965.*
b. *Second Report to the Department of Surgery January–June 1966.*
c. *Third Report to the Department of Surgery July–December 1966* (December 1966).

R15. *Comparability of Personal Medical Information assembled from Different Sources and at Different Times* (E. D. Acheson, M. R. Hubbard, and S. P. Watts).

R16. *The Fifteen Commonest Causes of Hospital In-patient Treatment in the Oxford Area* (1968).

R17. *The Incidence and Prognosis of Fracture of the Femoral Neck* (1968).

R18. *Some Comparisons between Admissions to the Fairmile, Littlemore and Warneford Hospitals in 1965* (L. J. Kinlen) (March 1968).

R19. *Follow-up-Data for Medical Research Workers* (1968).

R20. *The Fifteen Commonest Causes of Hospital In-patient Treatment in the Reading Area* (1968)

R21*a*. *First Gynaecological Report July–December 1965.*
b. *Second Gynaecological Report January–June 1966.*

R22. *Fourth Report to the Departments of Surgery January–June 1967* (August 1968).

R23. *Third Report to the Departments of Gynaecology January–June 1967* (August 1968).

R24. *First Report to the Departments of Medicine* (September 1968).

R25. *Accidental Poisoning and Self Poisoning in the Oxford Area in Children and in Adolescents and Adults* (September 1968).

R26. *Myocardial Infarction Management in Radcliffe Infirmary.*

R27. *Some Trends in Obstetric Care 1965–67.*

16. Operational research

J. B. CORNISH AND A. G. McDONALD

Discussion of operational research is bedevilled by the different ways in which people use the expression, and this is particularly so when research in health is the subject. At one extreme it is used to mean any research which is not basic, or laboratory research, and to encompass 'Applied Research' and 'Action Research', both of which suffer from the same verbal misuse—and at times abuse—as operational research.

The Nuffield Symposium in 1960 at Oxford on *Operational Research in the Health Services* (1) included a contribution by Dr J. H. F. Brotherston on 'Medical care investigations in the health service' in which he said: 'Need, availability, quality and administrative efficiency have been the main targets of investigation in medical care research. To these we should perhaps add another—the effectiveness of demand.'

The list of projects in Part III and other papers in Part II are a tribute to this economical and apt description of Brotherston's, for it encompasses much of the DHSS programme, if 'health' is substituted for 'medical' and the words 'and welfare' are added. The departmental funds made available for the work were described initially as for 'operational research', but this caused confusion and argument. Statisticians, economists, work-study experts, and other scientists and research workers whose skills are closest to the operational researcher, would quite frequently and fairly say that this or that project although relevant to the Department's responsibilities was not operational research. The title of the research programme had to be

changed into the more prosaic 'research into health and welfare services'.

In this paper we limit ourselves to describing the work done by scientists who regard themselves as working within the discipline of 'operational research'. The contribution made by such men and women is of two different kinds. The health and welfare services can make use of their general scientific ability now and, in modest ways, are doing so. But the essence of operational research, and what distinguishes it from other applied research, is the formulation of mathematical abstractions from reality which can be manipulated by the user to assess the probable outcome of alternative courses of action. The OR scientist starts by observing a system and assembling the most reliable data on its performance and then, from his conception of the system, formulates a hypothesis and constructs a model of it which he can use to predict the outcome of alternatives taking into consideration estimates of the uncertainties and risks involved. This can then be checked and counterchecked, often resulting in changes in the model. The process of prediction and checking is repeated until a reliable robust solution is obtained and implemented: the choices of the decision-makers at whatever level they function are then surer. The NHS is complex, encompassing the whole spectrum of medical care and welfare; it uses resources of trained men and women as well as a great number of buildings which in some cases are highly specialized. This complexity has been a barrier to the rapid development of OR in the service because the mathematical formulae and models only have meaning if all factors relevant to the problem being studied have been included within them. This requires the possession of judgement, insight, and sensitivity on the part of the OR team and an appreciation of the methods and uses of OR on the part of the providers and managers of national health services for whom they are working. Operational research will usually point to change in methods of working, and the planning and management of innovation is far from easy in the NHS.

The tasks initially facing the Department in the development of operational research in the NHS were to build upon the mathematical work of Bailey, Barr, Forsyth, and Newell, promoted by the Nuffield Provincial Hospitals Trust, to find effective ways of using men trained in OR and, most importantly, to discover how to carry through the changes suggested by their work.

This has been done by researchers in a wide variety of settings; as members of economics, statistical, mathematical, or operational research departments such as those of Barnard, Curnow, Haley, Lomax, Newell, Revans, Rivett, and Simpson; as staff of research units in a university institute such as that at Exeter directed by Ashford and Pearson and that at the London School of Hygiene directed by Logan; as staff of independent research groups such as the Institute for Operational Research and the Local Government Operational Research Unit; and as staff of hospital boards and industrial OR groups such as the OR Executive of the National Coal Board. At the same time as this work was proceeding, the need for an OR unit in the Department began to make itself felt, leading to the establishment of an OR unit last year. Some examples of the work done in the various settings follow, and a selection of published reports is given in Part III.

One example is the development of operational policies for new district general hospitals conducted by the Institute for Operational Research which aims to describe how individual hospital departments are expected to work, not only within the departments but also with other departments and services. After a preliminary study of the commissioning of a new out-patient department the Institute began work two years before the opening date with the staff responsible for the commissioning of the Walsgrave Hospital, Coventry.

Before OR techniques could be used the team had to spend considerable time and effort in the painstaking recording, retrieving, and processing of information, for little of the data readily available was of use to them. The team had also to get to know and develop working relationships with the many doctors, nurses, administrators, and other HMC and RHB staff concerned in bringing a large new hospital into use.

One outcome of potential general application has been the setting up of an information room in the Walsgrave Hospital after encouraging results had been obtained on a small-scale experiment at the Kersley Hospital. The three primary objectives are the administration of in-patient admission; to collect routine information required by statute; and to collect, analyse, and disseminate information of a more elaborate nature, for regulating the work of the hospital to make most use of scarce resources.

The information room could become the focal point for doctors and nurses to organize their activities especially the floor nurse superintendent and the registrar; at present it is run by the hospital secretary and is linked to a computer at Birmingham. The emphasis now is on ensuring that the system works well and that it is understood and used by the doctors and nurses; this implementation activity is sometimes forgotten or underestimated in operational research.

A later stage of the work will be to see whether the development of operational policies and of regular relevant information for day-to-day management and forward planning does in fact lead to more effective management of hospital resources within the city as a whole.

The work of the Institute for the Wessex Regional Hospital Board in developing management policies and information systems for 120-bed units has been of a similar kind but had one unexpected and important side-effect; the strengthening of the Board's management services team to help in the task of studying the existing system, persuading nurses and doctors to collaborate in experiment, explaining the innovation to other staff, training staff for the new ways of working, monitoring progress, and analysing the results. Each specialty has had to be studied separately, for each had its own problems, different needs for information, and, of course, different people working in it.

The knowledge gained by the Institute in these studies is being used in the planning of hospitals and other health facilities from the beginning in particular localities. It is very doubtful whether operational research can be widely applied without the existence of a strong resource within a hospital board for study, planning, persuasion, teaching, and overseeing experimental development. This seems to be true even where the operational research is carried out by the Board's own staff.

The emphasis of the OR undertaken by the National Coal Board Operational Research Executive has been on logistic problems: the purchase, production, storage, transport, distribution, collection, and processing for use again of stores and supplies of all kinds.

In its first project the Executive consolidated extensive work by the O & M staff of the Department and earlier OR studies into guidance applicable to both new and existing district general hospitals on stock levels in wards and departments and the method and frequency of replenishment of stores. A study of where stores should be held in

bulk and the economics of concentration is well advanced. Their most recent studies are of transport of stores, the location of area services such as laundry and the production and distribution of pre-cooked frozen food.

An interesting example of theoretical OR is the work of K. Aldred, while at Lancaster University, on 'factors affecting length of patients' stay: an approach to the determination of staffing levels for acute hospitals'. Following M. S. Feldstein (2), he made a preliminary study of the routine statistics of length of stay at thirty acute hospitals in which it was shown that length of stay for particular specialties was a characteristic of the hospital; in his main study he concentrated on eight acute hospitals in the Manchester Region to examine the effect on length of stay and hence on hospital costs of the level of staffing of doctors and nurses.

Other work in the Operational Research Department, Lancaster University, has been to study particular local situations and problems and to develop computer simulation models to predict the outcome of changing the organizational procedures and the resources of doctors, nurses, and accommodation (beds and theatres). Work at the Garnett Orthopaedic Clinic at Lancaster led both to a revised patient admission system and a mathematical model later developed to include the work of two or more consultants in the same speciality using common resources and then of two specialties using common resources. The simulations developed in this way have been described in a publication of the University (3).

Examples of other studies are work done by the Management Services OR Group of the Birmingham Regional Hospital Board with the assistance and guidance of Professor Haley. The two important projects that have been undertaken are to select the optimum number, size, and location of central sterile supplies departments for the region; and to develop a combined emergency admission system for hospitals in the Birmingham area.

The first study suggested substantial savings by concentrating the Central Sterile Supplies Department at fewer well-situated sites rather than in the nine smaller departments originally envisaged. The second study, which involves a substantial computer simulation model, showed the advantages that would arise from centrally controlled emergency admissions, in particular the more uniform use of hospital beds throughout the area.

Each of the settings from which OR has been carried out has led to useful work, but the actual and potential contributions are undoubtedly influenced by the setting and it should soon become possible from the experience gained to say which is most appropriate for each of the various levels of planning and management activity in the NHS.

We have so far described the historical origin of OR in the NHS and given some account of its development over the first few years. As a result of the experience gained it is now possible to think of the gamut of problems in the NHS which are capable of quantitative investigation as falling into one of three classes:

Strategic problems.

Operational problems.

Service problems.

STRATEGIC PROBLEMS

These are problems of strategy of such wide importance that they affect the service nationally. Some of these studies involve so many of the Department's activities that they need an internal unit familiar with the structure and working of the Department which can establish a continuing dialogue between the research teams and administrative divisions thus ensuring that the scope and limitations of the studies are well understood by policymakers. From time to time some aspects of a particular study need to be contracted out when the building of a particular model demands a considerable effort in a highly specialized technique but needs little immediate communication with the administrative divisions of the Department.

OPERATIONAL PROBLEMS

This class of problem has the characteristic that, while not of major importance to the question of strategy, it would be of importance to the efficiency of all members of a certain class of health or welfare unit. Much of the work already described is of this kind. In particular that of the Institute for Operational Research on hospital operational policies and that of the National Coal Board Operational Research Executive on logistic problems are good examples.

SERVICE PROBLEMS

In this class are the problems which may be important to a local health or welfare service unit or to a 'Cogwheel' executive, but are not likely to be relevant elsewhere, although study of a service problem may lead to generalization not foreseen at the start which will be of help in resolution of operational problems and to development of methods relevant to strategic studies.

The Department's own OR unit which was formed during 1970 is bringing together its own service and that of outside workers and developing a consolidated policy for tackling the three classes of problems described above. There seems little doubt that in addition to this central unit a number of different agencies are desirable: a few viable independent OR units devoted to help in the resolution of operational problems; a number of small teams who can tackle local service problems; and, depending on the nature and clarity of the problems, the use of independent consultant organizations to bring to bear quickly a wide range of skills and experience. The central unit itself is principally engaged on a study of resource allocation in the total health and personal social services. The aim is to contribute to the problem of how to provide the best balance of hospital and community health and welfare services. In the first phase of the work it is intended to identify the most important problems areas and then to construct a mathematical model, or set of models, which describe these. The models can then be used to study the effects of possible changes in the allocation of resources.

REFERENCES

1. DAVIES, J.O.F., *et al.* (1962). *Towards a Measure of Medical Care: Operational Research in the Health Services. A Symposium* (London: Oxford University Press).
2. FELDSTEIN, M.S. (1967). *Economic Analysis for Health Service Efficiency. Economic Studies of the British National Health Service* (Amsterdam: North Holland Publishing Co.).
3. HINDLE, A. (1970). *A Simulation Approach to Surgical Scheduling* (University of Lancaster: Department of Operational Research).

17. Research and the management of hospitals

J. B. CORNISH

> 'Now, because a great deal of what I have to say, if not heretical, will yet run contrary to the vogue and practice of the School for these thirty years, I will take the leap into my subject over a greater man's back. . . .' ARTHUR QUILLER-COUCH

Whenever two or more similar hospitals are compared, whether it be in the length of stay for hernia, the number of nurses on a ward, the money spent on food, the time a patient has to wait for an out-patient appointment or the satisfaction felt by patients for the care and understanding they receive, variations remain, even after allowing for known differences, which can only be explained by differences in organization and behaviour that in other settings would be thought of as differences in management.

Opportunities for the improvement of hospital management abound through the use of work study and O & M teams and management consultants; the development of costing, statistics, records, incentive schemes, and other traditional tools of management; and in education and training programmes. Nor is there any shortage of advice on how particular management tasks should be performed or on how hospital management should be reorganized. New patterns of management are being introduced for doctors and nurses and more fundamental changes are foreshadowed.

What part is research playing, and should it play, in this maelstrom of activity? Until recently its contribution has been small, and a description of modern hospital management, what it is and what it should be, based on research and accepted as valid, has yet to be written. This is not as surprising as it may seem for the difficulties are

daunting. Even in industry the achievements of research in management seem uncertain.

Lupton (1) has said: 'It sometimes seems to managers that recent research findings and the models constructed as a result of these merely demolish simpler, more useful, practical ideas without offering much of immediate value. For example, Joan Woodward's suggestion of a relationship between technology and management structure threw the adherents of the "classical" theories of formal organization into some confusion. Having regrouped, they tend to counter-attack on the ground that Woodward has had a good theoretical idea but it is not as practically useful as are hints about the art of delegation and the proper span of control.'

The study of hospital management is more difficult than the study of industrial management as research teams have quickly found. The tasks and goals of industry are easier to define and so are the hierarchies and the organization of work. The role of the professional in the hospital is more complicated than in industry, for although 'a parallel can be drawn between the complexity of batch production [in industry] and the large general hospital dealing with a variety of patients and diagnoses' (2), where in industry do the most senior managers work on the shop floor in the way consultants care for and treat patients in clinic, ward, and operating theatre?

Definitions of management illustrate some of the differences between industry and hospitals. The popular 'management is getting things done through people' is, of course, over simple, but is at first sight a promising theme to develop for hospitals. Lupton (1) has developed it for industry in two contrasting ways: 'Management consists in deciding in the light of the environing circumstances, what is to be done; in specifying the material, technical, and human resources required to do it; deploying them accordingly, and then getting things done through people'; and 'Managers create and control a technical and administrative environment, designed so that human skills and capacities may be used fully and effectively to pursue desired economic and social objectives'.

A consultant and a ward sister will between them do much that is in the first definition, but by no means all, but they would not recognize themselves in the second. Administrative officers help create the hospital environment, but do they control it? What are the objectives of the hospitals and who sets them?

The Department's programme of research into the management of hospitals was planned as a series of explorations to discover how best to overcome the difficulties found in the study of industrial management and in those peculiar to hospital management. The first studies commissioned tried to discover the mechanism of management by tracing the progress of particular activities. The tracer used by Rosemary Stewart and Janet Sleeman (3) was a national survey by hospitals themselves of the working of their out-patient departments which had been requested by the DHSS in an important ('pink') hospital memorandum.

They found that eleven of the thirty hospital management committees studied had a positive approach to the circular and made a thorough review, nine did almost nothing, and the remainder came in between. The amount of interest that the consultants showed in the circular, and their willingness to consider changes, seemed to be closely related to the amount of effort that the administrators had made to make individual contact with the consultants. Chester (4) also traced action on hospital memoranda, but over a longer period and more intensively. He explored the part played by the lay member in practice as distinct from theory. He demonstrated how long can be the process by which an idea conceived at a high level of administration is eventually grasped and implemented at the lower levels and how difficult it can be to change accustomed patterns of working. He found at one level of management a contrast between a serious and perhaps over-zealous attempt to concert the preparation of proposals for action on a hospital memorandum (in this case a hospital memorandum on reduction in nursing hours) including an appreciation of the financial consequences, and an apparent absence of such co-ordination and calculation. Nevertheless, at a higher level of management, the same arbitrary rules seemed to have been applied to the proposals prepared in such contrasting ways. The weakness was not necessarily in the behaviour of management at either level, but that both lacked the information necessary for planning, executive action, and control; they could not calculate with precision the consequences of alternative courses of action or of the decisions they took.

Both John Madge (5) and Chester supervised pilot studies of the care given to in-patients to illuminate management activity, but this form of tracer has not been used in a major study because of the

absence of indicators of the outcome of patient care, and of the difficulty of making judgement on the actions of professional staff.

The Institute for Operational Research also used in its study of decision-making in hospitals particular activities as indicators; for example, the consideration given to a proposal to build an intensive therapy unit, and the commissioning of a new out-patient department to serve two hospitals, one an ex-voluntary hospital and the other an ex-local authority hospital. In addition to observing the process of discussion and decision-forming (the decisions themselves were elusive, they were often taken at times when the research team were not present or in ways and places difficult to identify), the team provided information based on operational research analyses of data available.

They found a reluctance to use information of this kind, often because of doubt, frequently well justified, about the reliability of the data on which the analyses had to be based.

Doctors, nurses, and administrators have to provide the information on which statistics are based and they will tend to do so unwillingly and inaccurately unless they are able to use the end product, but they will only use the statistics if both confident of their accuracy and convinced in the first place of the usefulness of statistics to them in their day-to-day work. The impasse would be easier to resolve if the action indicated by statistical analysis and operational research could readily be agreed and taken. This is rarely so, as the companion paper on 'Operational research' indicates. But management cannot be carried out successfully without sound relevant information and it is for this reason that, as a supplement to studies of management activity, R & D funds have been provided for hospital activity analysis; for experiments in record linkage; for a professorial unit to design, develop, and use in a hospital region a medical information system; and whenever individual hospital staff have indicated a wish to be numerate in management.

Underlying these investments is the belief that the task of management will become easier when desirable changes and innovations can be better documented; the problems facing the manager wishing to change current practice remain formidable within the present system and much of the work of operational research teams (described elsewhere) and of a second group of studies of hospital management has been on the management of innovation.

Dr R. W. Revans, working in ten hospitals, and John Pantall, in two, have attempted to help hospital staff act upon conclusions drawn from earlier research; in particular Revans's *Standards for Morale* (6). Books are being written about both experiences; that on the experiment in ten hospitals is to be published about the end of 1971 (7, 8). It is an unusual account of action research in that it is written from several points of view; the hospitals each describe the project and their actions as they saw them; Revans provides his account, his team describe their own role, activities, and problems; and a detached observer comments on the whole and provides an evaluation.

A brief account, summarizing the principal features of the project, its achievements and shortcomings, and the lessons it provides for future action research projects, is also being prepared.

In Revans's studies, management education and development are not only an aim of his work but are components of his research technique. This is true of a third group of studies of hospital management by Lupton, Derek Williams, and Jaques.

Very few evaluations have been made of the management training of hospital staff. Lupton is currently studying that for ward sisters in one region; the results will be available in 1971.

Derek Williams (9), with support from local hospitals attempted to combine training for management with the study of management, and thereby to develop simultaneously his understanding of management roles and relationships and the appropriate training for them. He has just begun a development of his earlier work with a grant from this Department.

Jaques's work is based on social-analysis which, in his words (10), in essence: 'requires an individual or individuals in an organization, with a problem concerning the working of the organization, who seek the help of an analyst in determining the nature of the problem; . . . The starting condition for social analysis is therefore, that there are members of an organization who are concerned to go deeply into organizational questions, to get behind the façade of problems, to give up organizational and management clichés and to seek for reality-based solutions, to discover requisite organization despite the fact that the discovery may upset current modes of thought and of operation and on occasion require extensive reorganization.'

Jaques was invited shortly after he joined Brunel University to use these methods of study of organization, developed in the Glacier

Project, in the study of management in any hospital which invoked his help. Simultaneously he was invited by a regional hospital board to participate in its programme of management development.

From these beginnings a programme of both management teaching and study has grown which has been constrained only by the amount of work that Jaques and his team can undertake. Progress reports on the project are in preparation (11, 12).

Joan Woodward (13) made one of the first studies of hospital management in the NHS and has maintained her interest in it through supervision of a number of nursing studies and help in the development of the studies made by others. The Department has long hoped that she would return to the study of hospital management using the methods developed in her studies of industrial management (14, 15), and this hope has at last been realized. In 1970, with grants from the Social Science Research Council and the DHSS she began a study designed to discover how far her theories and principles of management developed in the study of industry are applicable to hospitals.

A common feature of all research exploration in hospital management sponsored by the Department is the freedom given to the explorers to use the skills and theories they have developed in research in other management situations in what seemed to them the most promising and rewarding ways. Not all can be successful, but those that are will point the way to sustained research and development. It is not expected that model patterns of hospital organization and management training will emerge, but it is hoped to discover concepts that can be used to design appropriate arrangements for particular situations; for if Lupton (1) is right 'The managerial applications of the concepts of social science are always and inevitably, to particular ment in particular groups in particular organizations, in particular economic, cultural, institutional and political environments. The same concepts will serve for the analysis, but the practical conclusions which follow from it might well differ, sometimes markedly, from situation to situation and from time to time in one organization, and certainly from organization to organization.'

REFERENCES

1. LUPTON, T. (1965). 'Social science and the manager', *New Society* (8 April), 12–14.

2. WOODWARD, JOAN (1970). *Behaviour in Organization* (Inaugural Lecture) (University of London: Imperial College of Science and Technology).
3. STEWART, ROSEMARY, and SLEEMAN, JANET (1967). *Continuously under Review*, Occasional Papers on Social Administration no. 20 (London: Bell).
4. CHESTER, T.E. 'Studies in hospital management', report in draft.
5. MADGE, J. Personal communication.
6. REVANS, R.W. (1964). *Standards for Morale: Cause and Effect in Hospitals* (London: Oxford University Press).
7. —— (ed.) (1971). *Hospitals: Communications Choice and Change* (London: Tavistock).
8. WEILAND, G.F., and LEIGH, H.E. (eds) (1971). *Changing Hospitals: A Report on the HIC Project* (London: Tavistock).
9. WILLIAMS, D. (1969). 'The administrative contribution of the nursing sister', *Public Administration*, Autumn, 307–28.
10. BROWN, W., and JAQUES, E. (1965). *Glacier Project Papers* (London: Heinemann).
11. KOGAN, M., *et. al.* (1971). 'Working relations in the British hospital service, (in the press).
12. ROWBOTTOM, R.W. (1971). 'Emerging patterns of hospital organization: a progress report on the Brunel project' (in the press).
13. WOODWARD, JOAN (1950). *Employment Relations in a Group of Hospitals: A Report of a Survey* (Liverpool: University Department of Social Science).
14. —— (1965). *Industrial Organization: Theory and Practice* (London: Oxford University Press).
15. —— (1970). *Industrial Organization: Behaviour and Control* (London: Oxford University Press).

18. Hospital catering

L. BEST

Good food ranks with good nursing and good medicine in the welfare of the person under hospital care. Guidelines on a uniform standard of food have been provided by the Department, based on studies of the provision and cost of food in hospital, but the standard of hospital food is influenced not so much by the type or quality of provisions purchased, or by the skill of preparation, as by certain factors present in the hospital service beyond those usually met in large-scale catering.

The first of these is the necessary long haul of hot food from kitchen to numerous individual and scattered bedsides. This gives rise to problems of keeping food hot and palatable as well as maintaining its nutritional value. Vitamin C, for example, is heat labile and therefore prone to destruction when food is kept hot. There are also managerial problems of communication and traffic flow.

The second factor is the very wide range of requirements. Hospitals cater for all age-groups from the very old to the very young, for persons in varying degrees of sickness or convalescence, for a large number of patients on special diets, and for staff. The proportions of these various categories are constantly changing. In these circumstances the accurate and timely notification of requirements, particularly when there is a choice, is almost impossible to achieve and consequently there is a tendency either to over supply and waste, or to shortages which take a disproportionate amount of time to rectify by way of supplementary collections or deliveries.

The third factor is staff utilization. At the production end of the line kitchen staff have to maintain an all-day and every-day service, and in many areas there is a shortage of this particular type of staff. At the consumption end, service of meals is traditionally under the supervision of ward nursing staff, who are professionally responsible for seeing that the patient receives his proper diet and whatever assistance is required to enable him to eat it. It is sometimes argued that in wards under pressure the most sustained contact between the nurse and some of her patients occurs at meal-times and that this contact ought to be preserved in the interests of the patient's welfare. On the other hand, organization and methods studies by the Department and hospital authorities have shown that about 10 per cent of the nurse's working day is taken up in the preparation and service of meals, and that in principle this task could be carried out with a saving of scarce skills—and with greater efficiency having regard to the other pressures on the busy nurse—by well-trained and supervised non-nursing staff. The attraction of this argument has gained force with the increase in the technical and clinical activities of the ward nurse, required by modern medicine, and the reduction of her working hours. There is too the possibility that time thus 'saved' would be absorbed in extra contact between nurse and patient, perhaps in giving explanations and encouragement as well as in the more technical aspects of 'care'.

A considerable amount of experimentation has taken place in methods of distribution and service of meals in hospitals and in the development of novel or improved equipment; but potentially the most attractive prospect, on all counts, is that emerging from the first stage of research and trials in the use of locally precooked and frozen food, recently completed at the Hospital for Women at Leeds. These trials, sponsored jointly by the Nuffield Provincial Hospitals Trust and the Department, were carried out with guidance and associated research and development by the Food Science Department of the University of Leeds (List no. 134).

The system installed comprises the cooking of food using conventional equipment, but by a batch-cooking process; the apportionment and packaging of cooked food in polythene bags; freezing by mechanical apparatus[1] designed to reduce the temperature of food

1. i.e. extraction of heat into rapidly flowing air. The cryogenic freezing process was not at the time sufficiently advanced to warrant consideration, but is now feasible.

from 80 to 5 °C in 75 minutes (speed in freezing is essential to preserve the texture of some cooked foods); distribution by cold trolley for reheating or temporary hold in ward refrigerator store; rapid reheating, by ward catering staff, in hot-air circulating ovens in specially designed portion containers; service by ward catering staff. A unique feature of the system is that the content of all food packages is adjusted to give a common reheating time so that with automatically time- and temperature-controlled ovens the reheating can be undertaken with unskilled staff. All equipment used in the process, including cooking utensils and reheating ovens, was assessed and developed or redesigned as appropriate by the research team. Tests were made on the whole range of hospital meal requirements. Recipes and techniques have been worked out for a wide range of dishes and guidance material has been produced.

The evaluation showed that the nutrient content of the food was higher than that obtained in conventional hospital cooking—the loss of ascorbic acid was reduced and there was less damage to protein. A series of surveys showed that patients and staff rated this method higher than that of the conventional (single menu) system originally in operation and as high as the conventional cooking system after the introduction of selective menus. Bacteriological test results compared favourably, there was lower wastage, and more intensive utilization of kitchen labour and equipment.

Factors which were not assessed because of the limited scope of this trial, but which are potentially of great significance, are:

1. The economics of bulk purchase of food at in-season prices.
2. Production is not geared to a meal deadline and staff work a normal five-day week: loss of overtime and weekend pay could be compensated by rewards for higher productivity.
3. Food distribution can be planned with regard to the pressures of other traffic on hospital services and facilities such as lifts and porters.
4. Virtually all special diets can be provided.
5. Consumers can select from the menu shortly before the meal. Under the best selective menu system a long advance notice is required to allow for collation of requirements.
6. Quality and food safety controls can be built into the system.
7. The system is capable of wide extension.

In view of this concept for hospitals and a similar potential for the use of frozen food in welfare establishments, the Committee on Medical Aspects of Food Policy was asked to advise on the nutritional and hygienic implications of greater dependence on frozen foods in welfare catering. A panel set up to consider this matter has reported to the committee that, subject to certain conditions being maintained during production, storage, transport, and reheating, the same standards of nutritional quality and hygienic safety can be maintained by using precooked frozen foods as in conventional catering. Guidance based on the report and including the panel's recommended code of practice will shortly be published.

The indications of the Leeds trial, and of one current in a group of hospitals at Dartford under the sponsorship of the South-east Metropolitan Regional Hospital Board and the King Edward's Hospital Fund for London, are favourable. More needs to be learned than either study can provide about the optimum efficiency and economic working scale and the implications for staff organization and training before the system is adopted on a wide scale in the NHS. It is also desirable, in view of the nature of the changes involved, that a comprehensive system be set up at this stage for demonstration and control purposes.

To these ends the Department is now planning with Newcastle Regional Hospital Board the installation of such a system in Newcastle hospitals. The system will be developed in stages round a purpose-built production and storage unit and will include a range of hospitals, psychiatric included. Each stage will be evaluated. The Food Science Department research team of the University of Leeds have been commissioned to participate in the planning, control, and evaluation of the development, and to carry out associated research in food technology; and management consultants have been invited to study staffing implications including the production of a productivity scheme covering all sections of the production and service areas.

Interim results of the first stage are expected in the later part of 1972.

19. Equipment and appliances research and development

1. Cardiac pacemaking

C. GREGORY AND GILLIAN R. FORD

Chronic heart block, a condition in which the nervous conducting mechanism of the heart fails to initiate or transmit the appropriate electrical stimulus, is now often treated with a battery-operated device which provides a substitute stimulus and is fully or partially implanted in the body. This method of treatment offers the possibility of re-establishing normal rate and rhythm, improving the quality of life, and restoring normal life expectancy (1). While comparatively few people in the UK receive this treatment, there were several reasons why this particular apparatus was selected for study and included in the equipment R & D programme in 1966.

There had been frequent reports of implant failure due to breaking of the catheter leads, electronic failure, early battery failure, and rejection of the implant. The short working life of the pacemaker (2) meant that patients had to undergo an operation regularly every year or two for replacement of the implant. There was always the possibility of sudden break-down between times, necessitating emergency action. This method of treatment was therefore good in theory but expensive in terms of apparatus, and unreliable and troublesome for the patient.

Staff from the Institute of Cardiology with officers from the Scientific and Technical Branch of the Department's Supply Division

made a detailed study of the reasons for failure: 81 per cent of all totally implantable units sold in the UK in one year (341 out of 421) were traced and reports on patients and failed units obtained. From this a composite picture of reasons for failure was built up. The next phase of the study was laboratory life testing of equipment under standard conditions. This work was carried out at the Atomic Weapons Research Establishment (AWRE) and formed part of a programme of R & D there, with funds supplied by the Department.

Some of the failures in circuitry and batteries were due to the encapsulation material. Epoxy resins are used to protect the circuits and make a container which is smooth and not likely to cause a reaction. In normal circumstances the resins are cured at elevated temperatures but in this case high temperature would reduce the battery life and a lower cure temperature is necessary. As a result the resins tend to change after manufacture with time and temperature: if they shrink the electronic components may fracture and moisture may seep through the resin causing corrosion at junctions of the circuitry. The programme of investigation led to the selection of a better type of encapsulation material and at the same time developments in electronic techniques made it possible to put the circuitry in a sealed metal container.

British pacemakers became considerably more reliable as a result of the modifications made. However, during the development work it became obvious that the major limiting factor was the life of the batteries themselves—theoretically three years but in practice only a little over two—and the search for an alternative source of power began.

The initial development work was carried out on pacemakers which provided a series of pulses at a fixed rate. By 1967 it was evident that this type of pacemaker did not meet the needs of patients with varying degrees of block, whose hearts sometimes beat at normal rates without assistance from an implanted unit. What was required for this group was a unit which did not stimulate during spontaneous activity, the so-called 'demand' pacemaker. In parallel with the development already described, work was therefore started on other power sources; and on the circuitry for the demand pacemaker.

The battery problem is being tackled by using a radioactive isotope as a source of power. The work on this is being carried out at the

Atomic Energy Research Establishment (AERE). Although this method of generating electricity is more expensive than others, it is in principle more reliable as well as more lasting.

Special criteria for design of the isotope-powered pacemaker are:

1. A working life of ten years.
2. An acceptably low radiation dose to the patient.
3. No possibility of release of the radioactive isotope from its capsule under any foreseeable condition of incineration or pressure.
4. No increase in size of the conventional pacemaker package, weighing less than 4 oz.

It is hoped that these units will be in general use by 1972.

A programme such as this is expensive and typifies the need for central research funds. During May 1965 to April 1966 only 421 units were sold in the UK including those used for treating new patients and replacing old units—hardly an encouragement for a commercial firm to carry out expensive research into improved design and performance. Collaboration between clinicians, hospital departments, AWRE, AERE, and industry has allowed experts from several disciplines including medicine and electronics to work together and advise each other and has resulted in the production of a better unit.

How many patients require this treatment? The cardiological committee of the Royal College of Physicians (1967) estimated that the number of new patients requiring this treatment each year was about 24 per million of the whole population. In 1969 only about 9 new patients per million received implants (3) while the number in Sweden was about 90 per million and in Denmark 40 per million (4). The extent to which a difference of this magnitude is due to a true difference in the incidence of heart block, or differing medical practice in the selection of patients within certain age-limits, or disenchantment with the performance of early pacemakers, is not known. It seems likely that, as the units become more reliable, the demand for treatment will increase quickly at least to the level of the RCP's estimate. Where is treatment to be carried out? The cardiological committee of the RCP recommended that permanent pacing should be done in hospitals with investigatory cardiac departments and physics departments. The committee also pointed out that in the interest of efficiency at least fifty insertions per year should be carried out at any centre undertaking this work.

Problems of concentrating treatment at particular centres remain. The situation which existed in 1965–6 when over 40 hospitals in the UK implanted only about 300 units between them does not seem rational. The Department has carried out a further survey to see how the situation has changed since then and although 1,211 units were implanted in England and Wales during 1969 only 8 hospitals approached the minimum total recommended by the RCP. It has been necessary to provide special development funds for two London centres (one is mentioned in Part III—List no. 1031) where much of this work on testing and evaluating is being carried out and where concentration of effort may give rise to a more efficient and economical service.

REFERENCES

1. SIDDON, A.H., and SOWTON, E. (1967). *Cardiac Pacemakers.* (Springfield, Illinois: Charles C. Thomas).
2. SOWTON, E. (1968). 'Result of a British survey on artificial cardiac pacemakers', *Br. med. J.* **12**, 11–13.
3. —— (1970). Personal communication.
4. KARLOFF, I. (1970). 'Pacemaking Symposium, Monaco' (Proceedings to be published)

2. Neutron therapy

G. E. GALE AND E. A. LENNON

The sensitivity of living cells, both normal and malignant, to damage by X- and gamma-radiation depends on their degree of oxygenation, the more anoxic cells being less sensitive (1, 2). It is thought that in many cases failure of radiation therapy may be due to survival of anoxic malignant cells with subsequent hyperplasia and dissemination. Hence the use during the past decade of hyperbaric oxygen combined with X-ray therapy. However, certain radiations with a high linear energy transfer produce a high density of ionization: the biological cell damage produced by this type of radiation is much less dependent on the degree of oxygenation of the cells, than the damage produced by radiation of low energy transfer such as X-rays or gamma rays. Of the many types available, neutrons are the most practicable for clinical application. They interact with tissue to produce protons which cause a high density of ionization in the tissue.

The use of neutrons in radiotherapy as an alternative to X-rays, gamma-rays, or electrons is currently the subject of much interest although still in the trial stages and the Department is supporting a major project in this field.

The background to this new development goes back to 1947 when Dr R. J. Stone in the USA (3) reported his results of the treatment of advanced cancer using neutron beam therapy. Following therapy in 249 patients, tumours regressed and in a number of cases disappeared completely, but there was severe damage to skin and normal tissues in the path of the neutron beam and some of the patients died from the effects of radiation. These complications were so serious that for some years it was considered impracticable to use neutrons for the treatment of cancer.

However, Bewley *et al.* (4) published the results of work on the effects of neutrons on the tissues of pigs. Their experiments suggested that a properly fractionated regime of irradiation would be effective in treatment of a malignant tumour but would not lead to the unwanted deleterious effects to healthy structures in the path of the neutron beam. Such a regime could be achieved by treating through multiple fields or by means of a moving field. The MRC is undertaking a study of the treatment of certain forms of malignant disease using a fixed beam of fast neutrons produced by the cyclotron at the MRC Cyclotron Unit, Hammersmith Hospital. For routine use and for treatment of tumours at depth a high-density neutron flux and a beam which can be rotated about the patient are required. The stimulus for development of such equipment came from Dr E. Easson of the Christie Hospital and Holt Radium Institute, Manchester, and led to the design of a neutron generator tube capable of producing a neutron flux of 1×10^{12} per second at an energy of 14 MeV. This has been developed from earlier tube design work at the Service Electron Research Laboratory, Baldock, and is being constructed under licence by Elliott Automation Radar Systems Ltd. It is to be held in a movable head which will be mounted on a rotating support frame similar to a modern Cobalt unit. The beam can be rotated about a fixed horizontal axis and this movement, combined with movements of the table on which the patient lies, makes it possible to use an isocentre setting up procedure. The table itself is made from perspex and resin-bonded wood in order to avoid problems of residual radioactivity. The tube housing and mechanical

equipment are being made by TEM Instruments Ltd. Two machines are nearing completion and will be installed at the Christie Hospital, Manchester, and the Belvedere Hospital, Glasgow.

These developments have been supported jointly by the Department of Health and Social Security and the National Research and Development Corporation.

REFERENCES

1. GRAY, L.H. (1959). *Lect. Sci. Basis Med.* **7**, 314.
2. —— (1961). *Am. J. Roentgenol.* **85**, 803.
3. STONE, R.J. (1948). Ibid. **59**, 771 quoted in ref. 1.
4. BEWLEY, D.K., FOWLER, J.F., MORGAN, R.L., SILVESTER, J.A., TURNER, B.A., and TOMLINSON, R.H. (1963). *Br. J. Radiol.* **36**, 107.

3. Control of incontinence

H. M. SIMPSON AND C. GREGORY

Incontinence of urine may afflict children and men and women of all ages. It is particularly associated with the young, with certain forms of physical and mental handicap, and with old age. In one study of the elderly, Exton Smith *et al.* (1) found more men affected than women but problems of management are more intractable in women. Women who have had a number of children are particularly prone to the complaint but it is not confined to the multiparous (2). The complaint causes acute social embarrassment and is not readily discussed with doctors so that its real incidence in the community may not be known. A small-scale study in Glasgow suggested that as many as 1 person in 4 is incontinent at the end of life and that 1 person in 40 remains incontinent for more than one year (3).

The condition can be controlled and sometimes cured by a variety of methods, depending on the patient's individual requirements and the predisposing cause. An article in the *Lancet* in 1963 by Mr K. P. S. Caldwell (4) of the Sphincter Research Unit at the Royal Devon and Exeter Hospital reported considerable success using a method of electrical control by means of an implantable muscle stimulator. The Department was asked for help in developing this method. This

project has also been supported since February 1965 by an MRC grant to Mr Caldwell and Dr Flack (5, 6).

The Department set up a small working party consisting of surgeons and physicists from five centres known to be working in this field and officers from the Department. A specification for the Exeter stimulator was drawn up, and fifty units were allocated to the participating centres for trial. The results of the clinical trials and the exchange of users' views brought about various changes to the design of the equipment, and the revised version is commercially available.

The complete stimulator consists of an implanted receiving coil with leads going to electrodes applied to the periurethral region and a small external radio-frequency transmitter. Pulses radiated from the external transmitter coil, which is taped over the position of the implanted coil, result in stimulating pulses being delivered to the muscle. Points of design considered by the working group included definition of the most suitable amplitude, duration, and frequency of the pulses to cover the widest spectrum of patients, and the method has proved successful in practice for selected patients.

Other methods which have been and are being considered by the working group are non-surgical methods using electrodes carried on a pessary-shaped applicator (7); mechanical supporting methods are used which are entirely non-electrical; and a more sophisticated electrical method producing pulses automatically only when required, the pulses being triggered by electromyograph signals (8).

The development of these methods of incontinence control is supported centrally. Collaboration of the manufacturers and research establishments such as the AWRE has been sought in order that full use shall be made of advanced electronics techniques and material technology.

By providing a forum for discussion of ideas from some of the leading experts in the field of incontinence control, and ensuring that equipment is available by funding the design and provision of quantities for trial, the Department hopes to make a useful contribution to the management of this complaint. It is unlikely that any single method will provide the complete answer, but a choice of equipment will be available for patients and their doctors.

Easy access to toilets, appropriate clothing, care in sedation, and sympathetic understanding may help some of the elderly to manage their own incontinence problems. For the people for whom devices

to control incontinence have not been effective, methods have to be found to collect the urine with minimal inconvenience. A considerable volume of work has been expended on producing appliances which can be attached to the body and in finding ways of protecting bedding, clothes, and furniture. Summaries of published material on these subjects are contained in a selected bibliography shortly to be published by the Disabled Living Foundation.

Members of the DHSS staff have served on project or advisory committees of organizations such as the Disabled Living Foundation and the King Edward Hospital Fund which have particular interests in non-medical problems of incontinence and the latter in research in textiles in association with the Shirley Institute. The Department has been directly concerned in work on bed linen, incontinence pads, and wheelchairs.

The Department's Working Group on bed linen investigated the effectiveness of drawsheets, incontinence pads, waterproof undersheets, and waterproof pillowcases and reported in 1968 (9). The working group made a useful distinction between the comfort drawsheet, which can be 'drawn through' to provide a cool place for the patient to lie on, and the incontinence drawsheet designed to protect the bedding from soiling and not 'drawn through'. A questionnaire revealed the wide variety of specifications in use and the working group in consultation with manufacturers suggested a sheet 45 in. × 72 in. with a high absorbency obtained by specifying a cotton twill fabric with a condenser-spun yarn in the weft.

For incontinence pads specifications were drawn up in accordance with Norton's findings (1). After further field trials in three hospitals (10) modifications were made in the suggested size and absorbency of the pads. Flammability trials on incontinence pads are being carried out at the Shirley Institute on behalf of the Department as part of a study into the fire hazards caused by patients smoking in bed.

Responses to a questionnaire indicated that rubber undersheeting was unpopular with patients and staff, polythene was widely used but PVC sheeting was found to have advantages both for undersheeting and for the protection of pillows. PVC material to BS 3878: 1965 (Type 3) was recommended for general use. Foam mattresses which are replacing latex mattresses and are available on central contract are covered with an impermeable mattress cover made from polyurethane-coated nylon. Such covers will be available under a

new contract for spring-interior mattresses. Where these covers are used, and particularly with incontinence pads, protective sheeting should not be necessary.

Many incontinent people have to use wheelchairs. In 1969 the Department produced a handbook (11) to guide in the selection of wheelchairs for patients with particular disabilities. One model provides two alternative arrangements as a commode. One style has a latex foam cover over the aperture, the other a latex cushion with a permanently exposed aperture. Further work on movable commodes is currently in progress at the Royal College of Art and the Department is represented on the associated committee.

Incontinence presents a singularly intractable problem to cure, control or manage. It afflicts large numbers of people and is a cause of much discomfort and unhappiness. Something can be learned from work already completed but this is an area which will offer a challenge to research workers for a long time to come.

REFERENCES

1. EXTON SMITH, A.N., NORTON, D., and MCLAREN, R. (1962). *An Investigation of Geriatric Nursing Problems in Hospital* (National Corporation for the Care of Old People).
2. NEMIR, A., and MIDDLETON, R.P. (1954). 'Stress incontinence in young nulliparous women: a statistical study', *Am. J. Obstet. Gynec.* **68**, 1166.
3. ISSACS, B., MCMILLAN, I., and MCKECHAN, A. (1969). *Life before Death.* Paper presented at King Edward Hospital Fund for London Conference.
4. CALDWELL, K.P.S. (1963). 'The electrical control of sphincter incontinence', *Lancet*, **ii**, 174.
5. —— (1968). 'Treatment of post-prostatectomy incontinence by electronic implant', *Br. J. Urol.* **40**, no. 2.
6. —— (1968). 'Stress incontinence in females: report on 31 cases treated by electrical implant', *J. Obstet. Gynaec. Br. Commonw.* **75**, no. 7.
7. ALEXANDER, S., and ROWAN, D. (1968). 'An electric pessary for stress incontinence', *Lancet*, **i**, 728.
8. VINCENT, S.A. (1968). *Proc. R. Soc. Med.* **61**, 700.
9. DEPARTMENT OF HEALTH AND SOCIAL SECURITY (1968). *Main Report of the Specification Working Group on Bed Linen.* Confidential report implemented 1968.
10. HENDERSON, D.J., and ROGERS, W.F. (1971). 'Hospital trials of incontinence pads', *Nursing Times*, **1**, 141.
11. DEPARTMENT OF HEALTH AND SOCIAL SECURITY (1969). *Handbook of Wheelchairs and Hand Propelled Tricycles* (DHSS).

4. Automatic pattern recognition

C. GREGORY AND J. M. G. WILSON

Much of our thinking capacity depends on the ability of the brain to associate and analyse the information entering through the organs of sense; that is, we recognize patterns the significance of which we have learned. For instance, we can often recognize the pattern of measles visually by seeking a characteristic rash, pink eyes, and spots on the inside of the cheeks. Our ability to diagnose the pattern depends on our having the necessary information—the correct program in the computer sense. There is, for example, a photograph in a certain article on observer variation which shows a picture which looks exactly like an oval biological cell seen under high microscope magnification. It is not actually a cell at all but an aerial picture taken from some 30,000 ft of a football stadium packed with spectators in which a game is in progress—the spectators are the faintly granular 'cytoplasm', whilst the players represent the nuclear 'chromosomal material', the outer fence and the crowd barriers forming the 'cell membrane' and 'nuclear membrane' respectively. The missing bit of information the observer needs to make the correct diagnosis is the distance of the camera and the magnification of the object. This introductory note may seem a far cry from the needs of the NHS but there is a real connection as we shall see.

Much of our medical training goes into helping us recognize visual patterns and much of our doctors' and trained technicians' time is taken up with the routine search for recognizable visual diagnostic patterns. For instance, in haematology, morbid histology, and cytology much of the diagnostic work consists of examining material under the microscope and looking for patterns of abnormality due to disease. If the diagnostic information sought can be systematized sufficiently to program a computer, pattern recognition using some form of television scanning device becomes a practical possibility.

The ideal problem to bring to this kind of solution is the screening situation, where large numbers of specimens from mostly normal populations need to be examined routinely in the attempt to find the few people with disease characteristics, perhaps only a very few per thousand examinations. Mass chest radiography, haematology, and cervical cytology are important examples of this type of screening

service. For at least a decade work has been in progress on instruments to carry out a preliminary screening examination of cervical cytological preparations. In many ways this is the ideal problem for automatic pattern recognition. Cytological screening is provided for the adult female population and many thousands of specimens annually are taken up and down the country. These specimens can be preserved at the time of taking and sent by post to a central laboratory capable of carrying out very large numbers of examinations. The cytology laboratory at the Christie Hospital in Manchester is, for instance, examining cytology preparations at the rate of 95,000 a year. To do this it employs 36 technicians (22 part-time) working under the pathologist in charge. Equipment to off-load much of this work from the human technician would release scarce manpower for other work and could well effect useful savings over a period of time. Diagnostic X-ray screening provides an equally desirable area for attack, though the problems of pattern recognition of X-rays are even more severe than those of cytology; and if, in addition to chest radiography, X-ray mammography for the early diagnosis of breast cancer becomes established as a screening service, the use for the automatic pattern recognition of X-rays would become even greater. The differential white cell count of blood cells is another routine laboratory procedure for which pattern recognition would be extremely useful. However, X-ray reading is a particularly difficult recognition problem. The automation of the differential white count may be a practical possibility.

Most of the work supported by the Department so far has been concentrated on exfoliated cell recognition for cervical cytological screening. Chromosome pattern recognition is being supported by the MRC. The examination of cells for chromosome abnormality is an important aspect of the academic study of genetic disease both in families and in large population samples, and of practical genetic counselling: it is also necessary for the recognition of certain adverse effects which may be produced by noxious agents—either physical or chemical—in the environment. The examination of cells for abnormal chromosomes is lengthy and tedious so that mechanical recognition and counting, if it comes, will be an extremely practical advance.

Much work has been carried out on identifying the essential characteristics of malignant and pre-malignant exfoliated cells which are thought to be diagnostic. The main characteristics appear to be the

total cell size, the density of pattern of staining of the nuclear chromosomal material, and the nuclear : cytoplasmic diameter ratio. Progress has been made in programming automated sensing equipment to measure and signal cells with these characteristics. Projects of this kind are being supported at several hospitals and institutions. Other work is being carried out on improving the systems needed for the presentation of exfoliated cellular material to the sensing equipment. In brief this apparatus automatically makes linear cellular smear preparations of exfoliated cervical cytological material (most of the work supported by the Department has been on this material, but the technique could, of course, be applied to other biological samples, for example blood, or urine if the cell content were suitably concentrated). The smear is made on a continuous strip of transparent plastic film and is then automatically fixed, dried, and stained; it is then covered with a protective layer of adhesive film, in place of the cover slip of a conventional slide preparation. The stained film is now ready to be passed across the stage of a specially adapted microscope, which is connected to the sensing equipment. Some automated apparatus for laying and staining cells is being evaluated and is undergoing trials in hospitals.

There still remains much work to be done before equipment suitable for service needs is likely to be produced. Not least, more needs to be learned about the diagnostic parameters of malignant and other cells and a group of UK experts is examining this problem. The Department is also in close touch with the MRC which is carrying out research into automated equipment for chromosome analysis in its Clinical and Population Cytogenetics Unit.

In summary, pattern recognition offers some hope for the future in replacing technicians and doctors in much repetitive routine work, thus releasing them for other productive work. The problems attached to pattern recognition are, however, not easy to solve and it is likely to be some time before service equipment makes its appearance.

5. Thermography

G. E. GALE AND E. A. LENNON

Thermal imaging or thermography as it is often called is a technique by which a picture of the variations in temperature over the surface of

the skin can be formed and recorded. It is possible to detect temperature differences down to and even below one-fifth of a degree centigrade. The skin is continually emitting infra-red radiation although the amount emitted depends on or can be modified by conditions existing below the surface. Provided the ambient temperature is steady, local variations in skin temperature usually depend on variations in the blood circulation in that area although sometimes increased metabolic activity may be involved. Such temperature variations are often entirely normal; for example a large blood vessel near the surface can be detected thermographically—it reveals itself as a relatively warm streak—and indeed this is one means by which the clinician may be able to decide whether the circulation is normal or not. More importantly, 'hot spots' may indicate serious disorders; thus noticeably higher temperatures are detected in the region of a tumour. At the same time hot areas may be caused by local infections or inflammation and benign as well as malignant tumours may be detected. Exceptionally low temperatures might indicate areas of dead tissue or those where circulation is absent or defective. As is the case with X-radiography, skill and experience are needed to interpret the thermal pictures that are obtained. The temperature of the environment has to be steady and a cooling period allowed for after undressing.

The great advantage of thermography is its safety; no radiations electromagnetic or ultrasonic are involved and no pre-medication is required; this has stimulated exploration of its value as a diagnostic tool.

In the early days skin temperatures were measured directly by means of thermocouples or in other ways, but all equipments currently in use depend on observing infra-red radiation. A not untypical though rather advanced machine operates as follows. The heat from the part of the patient's body that is being scanned is received on a mirror which oscillates across the field of view and is reflected into a drum rotating at 600 cycles per minute. This drum contains twelve mirrors mounted around its inner wall. An image is thus formed at the centre of the drum on yet another mirror and from this is transmitted to the actual detector unit. The detector itself, which is single channel, consists of a chip of indium antimonide which must be cooled to 77 K. Two temperature references are provided within the system and there is also a range-finder which assures that the whole equipment is focused accurately on the patient. This last device can

also be used to indicate visually to the operator the location of hot spots on the body.

After suitable processing, the signal from the detector is passed to a display unit of the television type. This display can be studied and photographed. In addition selected portions of the field of view can be analysed to provide a numerical display of temperature in that field. Other variants of the display, including one showing temperature contours, are possible.

The machine described above is intended to demonstrate the feasibility of high-speed quantitiative thermal imaging and to enable the clinical value of the technique to be still further explored; and it is rather more sophisticated than some other models. It was developed by the Atomic Weapons Research Establishment, and Department funds have been used both for the development work and for the evaluation of the equipment in different clinical situations.

Most of the interest in the application of thermography has been in its use in the diagnosis of breast cancer. The group working with Professor K. T. Evans at Cardiff Royal Infirmary has found that about 85–90 per cent of breast cancers in women with symptoms will be correctly diagnosed on either palpation or mammography alone, the incidence rising to about 95 per cent if both are used. Thermography alone was accurate in only about 50 per cent. The failures with thermography may be due to the nature of the tumour or to its position. The sub-mammary fold often appears 'hot' in normal breasts and this is thought to be the main reason for a high false positive rate (25 per cent) with thermographic techniques (1). At present, thermography is useful as an ancillary tool in the diagnosis of breast disease, although a high incidence of false positive and false negative results seem to preclude its use in population screening.

Research is continuing on the use of thermographic techniques in other fields. Two fields in which it seems to hold some promise are the localization of incompetent perforating leg veins and the assessment of full thickness burns and the optimum time for attempting grafting. Work on these aspects is being carried out by Mr K. Lloyd Williams (Bath) (List no. E28) and Mr M. J. Hackett (East Grinstead) (List no. E24) respectively. Studies of the cerebral circulation, secondary malignant deposits, and osteo-sarcomas have also been made with this technique.

Much remains to be done, both as regards improving the speed and sensitivity and specificity of the equipment. Clinical experience is accumulating but validation of the technique requires its limitations as well as its potentialities to be explored and studies are being supported to this end.

REFERENCE

1. FURNIVAL, ISOBEL, G., STEWART, HELEN J., WEDDELL, J.M., DOVEY, P., GRAVELLE, I.H., EVANS, K.T., and FORREST, A.P.M. (1970). 'Accuracy of screening methods fot the diagnosis of breast disease', *Br. med. J.* 461–3.

20. Biomechanical Research and Development Unit (BRADU)

D. S. McKENZIE

The Artificial Limb Service undertakes the care of a population of about 69,000 amputees in England and Wales. The intake of new amputees in 1969 was 4,455 and the annual intake has been increasing at about 3 per cent over the last decade. There are twenty-two limb and appliance centres in England and Wales to serve their needs not only immediately after amputation but for care and maintenance for the rest of their lives. These centres are staffed by full-time medical men together with supporting staff, and provision is made for all aspects of rehabilitation. The limbs are made and fitted by contractors to the Department under the guidance and control of the Department's doctors and technical staff.

The predominant cause of amputation in Britain, in common with most western civilizations, is degenerative disease of the arteries. Seventy-five per cent of the new patients with leg amputations seen in 1969 had suffered amputation for this reason. In the nature of things, arterial disease manifests itself mainly with advancing years which is reflected in the fact that 60 per cent of the new patients with leg amputations were 60 years of age or more. Furthermore, this group tends to have multiple handicaps and to have a limited expectation of life. Fifteen per cent of those referred for limb fittings were found to be not fit to undergo the strain of learning to use an artificial limb, and 14 per cent of those who tried failed to make use of a leg (1). Obviously those who have lost the leg above the knee are at a disadvantage compared with those whose knee has been preserved, and it is satisfactory to note a trend towards the more conservative

amputations which no doubt derives from the growing realization that the surgery of amputation requires meticulous technique and expertise. Thus in the period 1948–51 only 17 per cent of amputations for arterial disease were performed below the knee (2), whereas in 1969 there were 28 per cent.

In contrast, amputation of the arm is seldom caused by arterial disease (only 5 patients out of 449 in 1969). Sixty-three per cent were due to accidents and 21 per cent were congenital deficiencies. It is not surprising, therefore, that the intake of arm patients is predominantly young active people—28 per cent under 20 years and 85 per cent under 60. Arm amputations are less frequently performed than those of the leg in ratio of approximately 1 to 9.

One other factor which should be stated is that owing to the brief life-span of the geriatric group the ratio of active leg users in the population of patients under care is in the order of 60 per cent and the arm users to leg user ratio about 1 to 4.

BRADU in its purpose-designed new building was officially opened by the then Minister of Health, the Rt Hon. Kenneth Robinson, on 19 January 1967. Bearing in mind the service organization and demands which have been rather briefly indicated above, it seemed that there were four main categories of users to whom the Unit might be of service—the elderly leg amputee, the active leg amputee, the arm amputee, and the congenital severely deficient child such as those born to mothers who had taken thalidomide during their pregnancy, each group having different needs.

THE ELDERLY LEG AMPUTEE

The elderly amputee requires of his prosthesis comfort, lightness, simplicity, ease of donning and doffing, and above all security and stability. He requires the minimum delay in providing his limb. He is somewhat less concerned with appearance, but this is important to some. He looks for only limited mobility and personal energy expenditure is at a premium.

THE ACTIVE LEG AMPUTEE

The active leg amputee requires comfort, mobility, and an acceptable standard of normality of appearance in movement pattern and at rest. He is prepared to put some effort into driving the limb to attain these objectives but is conscious of energy expenditure and grateful

for any device that spares him this, so that he requires sophisticated mechanisms. He is concerned with manoeuvrability on rough terrain and in confined spaces and may have quite active avocations which he wishes to pursue. He does not wish to lose working time when his equipment is defective or ill-fitting, so that a quick repair and replacement service is important.

THE ARM AMPUTEE

There are three readily discernible types of unilateral arm amputee—those who wish to return to full bilateral manual activity, those who wish only a sleeve-filler with minimal social activity such as holding a table knife and those who do not wish to be bothered with an artificial arm. The bilateral amputees require to have function and, by and large, accept the most functional appliances even at the cost of appearance. Almost all would wish a restoration of appearance, and comfort is, of course, essential. There are grounds for belief that the sooner an arm is fitted after amputation, the more likely it is to be acceptable and that even hours of delay may be important.

CONGENITAL ARM DEFICIENCIES

Children with gross congenital deficiencies are in a class by themselves and their needs will be discussed in the section on powered limbs below.

It seemed that there were six main areas in which BRADU's resources could operate effectively without duplicating work being undertaken elsewhere.

Clinical. This involves seeking out the practical needs, preparing the clinical design criteria for devices or techniques and determining the fundamental data necessary for this purpose, developing clinical techniques, trials on patients, and evaluation of new techniques and devices, preparation of the relevant instructional handbooks, and teaching and supervising their introduction into service.

Sockets. The socket is that part of the artificial limb which is applied to the stump and through which the weight of the body and the forces required to manipulate the limb are transmitted, and its correct design and fitting is obviously of prime importance to

the comfort and function of the user. Each must be tailored to the individual stump. Hitherto, fitting has been largely empirical and has involved hand-sculpturing to an extent that even the most skilful fitter is unable precisely to duplicate a socket for a given stump. There is plainly scope for error. Furthermore, transmission of the body weight to the socket has been concentrated on restricted skin areas known to be relatively tolerant of weight bearing, but this has resulted in excessive local pressures so that it was desirable to make use of much larger areas to distribute the load—preferably the whole surface of the stump. The Unit has developed a technique which achieves this for above-knee stumps with a high degree of reproducibility and this is now in process of being introduced into service. Approximately 200 patients have been fitted to date with a very promising success rate. This fitting method has the potential to be of direct benefit to some 25,000–30,000 patients in the amputee population in England and Wales and perhaps 800 new patients each year. It has already been adopted in Sweden. Work has started on devising a comparable technique for below-knee stumps.

Surgery. Amputation is a unique wound and little is known of the conditions influencing its healing. BRADU has designed the apparatus and instrumentation to control the environment of the healing stump and a study in close collaboration with the orthopaedic and vascular surgeons of the adjacent Queen Mary's Hospital is planned.

Structures and mechanisms. The limb-making contractors have their own development units which are well capable of designing improvements to existing limbs as well as many new devices. Rather than duplicate this work, BRADU's role must be to stimulate such development by showing areas of need, providing design criteria and testing and evaluating the products and, where this is wished, financial or practical support. This may entail feasibility studies possibly to the extent of designing and fabricating models of prototypes in our own drawing office and workshops. Additionally BRADU may feel it necessary that they themselves should do the design and development of devices which, though clinically desirable, are not seen to be commercially attractive by the contractors, or where BRADU's resources are agreed to be more able to tackle the problem.

The methods of fabricating existing artificial limbs are cumbersome and take an unacceptably long time. The solution lies in

modular systems whereby components and sub-assemblies are manufactured centrally by modern techniques and stocked at the peripheral centres for rapid assembly and fitting on the spot. Criteria for such a development were laid down by BRADU. The manufacturers have developed systems which go a long way towards meeting the criteria and are in process of being introduced into service. BRADU felt it necessary to undertake a somewhat parallel development both to ensure that the full design criteria could be shown to be feasible and to study the logistic implications on the service as a whole. A pilot exercise with this latter end in view is planned to start in 1971 at one of the peripheral limb centres.

Fundamental research. The technology of artificial limbs is relatively primitive, it still being essentially a craft industry. A significant contribution was made just after the war at the University of California, Berkeley, resulting in the first comprehensive biomechanical analysis of gait (3). This project, being undertaken in the pre-computer era, though extremely wide in scope, inevitably used rather small population samples. Nevertheless the work was so monumental that it has never been validated by repetition on larger samples. It was therefore necessary for us to install sophisticated data acquisition and handling equipment so that we may confirm these measurements before using them as a basis for design criteria and so that we can study other phenomena as the need arises. Our equipment can record fourteen channels of information and incorporates both an analogue and a small digital computer. Present studies embrace the distribution of pressure within sockets, knee dynamics, foot placement in walking, etc. Somewhat similar facilities exist at the University of Strathclyde with which we are in close touch (4).

Powered limbs. The moving parts of conventional artificial arms are driven by cables from various forms of shoulder harness. They can be operated effectively by any amputee with a reasonable stump even if the elbow is missing providing the shoulders are relatively normal, and the user has a surprisingly precise 'feel' of the resulting performance of the arm. The introduction of an externally powered motor deprives the user of all of this sort of sensation, or 'feedback' as the engineers call it, and no completely satisfactory artificial substitute for this has yet been found (5). The user is unable to use the arm

without deliberately thinking out every movement and he can never perform all tasks subconsciously. There are therefore reasons for doubt whether external power has anything sufficiently worthwhile to offer the average amputee in exchange for the extra complexity, vulnerability to failure and cost until these control problems are resolved. However, when one comes to bilateral complete absence of the arms or vestigial arms such as are characteristic of the thalidomide children, a great many more movements have to be driven and there are fewer available control sites so that one is forced into adopting externally powered systems. Other laboratories, notably those at the Princess Margaret Rose Orthopaedic Hospital, Edinburgh (6), and the MRC Powered Limbs Research Unit, Hendon (7), were already established and specializing in these problems before BRADU was formed. BRADU has therefore adopted a supportive and co-ordinating role in this field and is also financing some research projects in universities and other laboratories selected for their individual expertise. One of the problems already limiting the development of these devices is that of energy storage in a form sufficiently light and compact to be portable. The Unit has been responsible for the design of a pressure vessel to hold liquid carbon dioxide (the power source in present use) which is probably about the ultimate in size and weight which will be tolerated by patients, and this is now under production. An experiment is also being mounted in which it is hoped to show whether indeed there is any measurable advantage in external powered devices for conventional amputees.

To meet these various tasks BRADU has been organized into three main laboratories, clinical, measurements, and electro-mechanical design. Supporting services are provided by a design drawing office, a model shop, a plastics shop, and the library.

It will be recognized that a short paper such as this is an over-simplification of the tasks facing the Unit and the way the Unit has set about them. Nor has it been possible to acknowledge the help from many organizations and individuals.

REFERENCES

1. Department of Health and Social Security (1970). *On the State of the Public Health* (London: HMSO).
2. McKenzie, D.S. (1953). 'The elderly amputee', *Br. med. J.* **1**, no. 4802.

3. *Fundamental Studies of Human Locomotion and Other Information Relating to the Design of Artificial Limbs.* University of California, Berkeley, covering period September 1945–June 1947. NRC Committee on AL Advisory to the Veterans' Administration and the Office of the Surgeon General, US Army, July 1947.

4. HUGHES, J. (1967). 'Dynamic gait studies applied to the design of lower limb prosthesis', *Proc. Internat. Symp. Ext. Control of Human Extremities, Dubrovnik* (Belgrade: Yugoslav Committee for Electronics and Automation).

5. MCKENZIE, D.S. (1970). 'The functional replacement of the upper extremity today' in *Prosthetic and Orthotic Practice*, Murdoch, George (ed.) (Edward Arnold Ltd).

6. SIMPSON, D.C., and SUTHERLAND, G.D. (1965). 'The development and control of a powered prosthesis for children', *Inter-Clinic Information Bull.* **5**, no 3. (December).

7. KINNIER-WILSON, A.B. (1965). 'Hendon pneumatic power units and controls for prostheses and splints', *J. Bone and Joint Surgery,* **47B**, 435.

Further bibliography may be obtained from the author.

21. Building and engineering

H. GOODMAN

For some years the research and development efforts of the architects have been concerned with two aspects of the health building programme. The first of these is to rationalize the way in which information is processed, particularly between the briefer/designer and the manufacturer/constructor, from the briefing stage until the final completion and evaluation of the building. This exercise has concentrated on the use of systems analysis and has assumed the handling of this stage by means of computer. This exercise has had the code name 'CUBITH'.

The second study has been concerned with attempts to standardize the actual planning of hospitals (and other health buildings) within a common dimensional and structural framework and to produce a range of unique but standardized hospitals. This exercise has been known as 'HARNESS'. Recently the feasibility of using computer-aided design techniques in the HARNESS exercise has led us to the point where these two exercises can be logically combined using the 'How' of CUBITH to achieve the 'What' of HARNESS.

Our earlier development projects have several common themes: the search for a universal hospital structure, the study of flexibility and adaptability, the study of hospital communications, the integration of structure and engineering services, and the satisfaction of all these requirements within acceptable cost limits. The 'Best Buy' hospitals attempt to capitalize on all the work that has gone into earlier projects and at the same time to produce a cheaper building form; they also take advantage of the change in medical developments

which means they could be a more 'high-powered' hospital. Although it was only realized later, the most significant fact was that *two* 'Best Buy' hospitals were to be built; the significance was not that this produced certain economies but that two quite different clients some 200 miles apart were prepared to accept identical buildings and these buildings were tolerant to varying local operational policies. This acceptance by the client was the most significant prerequisite to further work done on standardization. At this stage it might be worthwhile considering why the Department considered that standardization of hospital planning was desirable. We have been designing and building hospitals on a 'one-off' individual basis for many years and some extremely satisfactory buildings have emerged. However, circumstances have changed and we are suffering from severe shortages of money, time, and professional skills. Standardization seemed to offer us possibilities of savings in all these fields. Possibly the biggest initial saving is in the scarce planning skills needed to build what are fast becoming some of the most sophisticated and complex of all building types. Procedures in medicine and management are becoming ever more advanced and planning solutions to them become more and more complex. It is becoming increasingly difficult to find the skills necessary to provide the individual solutions and at the same time to produce buildings which are sufficiently sensitive to changes in that their designs may be rapidly updated.

The clients, that is the doctors and the administrators, are becoming increasingly intolerant of the frustration and delays in producing a modern hospital and there is evidence the clients are possibly ahead of the designers in their willingness to accept a standardized solution. Indeed a near revolution has taken place in the medical field with a high degree of acceptance of standardization in medical and nursing procedures, equipment and supplies.

It is obvious that before standardized planning solutions can be produced the operational policies must be co-ordinated, although only those which have an effect on the planning. A fairly cursory examination of the problems shows that there are surprisingly few operational policies which it is essential to standardize before planning can proceed. Outline draft operational policies have already been produced by the HARNESS team and circulated to the regional hospital boards and a large measure of agreement has already been received.

Before attempting to analyse all the hospital types available and the limitations on solutions it is worthwhile considering the market for standardized hospitals. Should we go in for 100 per cent of the building programme or limit ourselves for a variety of reasons to a proportion of this? Not all hospitals are new and many of the redevelopments are too small to be susceptible to standardization. Many sites are difficult in terms of shape or contours or congestion or have problems of phasing too difficult to overcome in a rational way. All these factors lead us to think, certainly at present, that we should consider a market which might comprise about 70 per cent of the total building programme.

It is the opinion of our team that the prime criterion of the feasibility of a programme of standardization is its ability to produce a unique solution, that is to say that standardization only works when it gives the client what he wants. Our approach in the HARNESS exercise to the standardization problem lies in the study of the communication pattern of the hospital. This pattern of movement of communication determines the shape of the hospital and its departmental relationships; it controls its flexibility and may determine its management structure. If we can in some way analyse this communication pattern and determine the 'rules of the game' through departmental relationships within the hospital then we may be going some way towards the dual problem of rationalizing the planning process and yet producing unique solutions.

Many of the studies carried out by the DHSS or by its commissionees in recent years suggest that the most economic and efficient hospital planning solutions are in the range of medium compact, low rise, largely naturally ventilated types of building and it is the communication pattern of this type of building that attempts have been made to analyse. These 'patterns' of organization and movement which generally show themselves in the physical communications of the hospital can be identified as linear, H-plans, cruciforms, T-plans, and ring main. The identification of this generic communication pattern is the origin of the code name 'HARNESS' for this exercise as it is the HARNESS to which all departments of the hospital are plugged. There appear to be certain criteria which when applied to these various shapes determine their suitability as hospital planning solutions in a specific context. These rules are geared to time/distance studies automatically predetermined to some form of interdepart-

mental relationship based on some hierarchical system of relationship to produce acceptable solutions. It is obvious, therefore, that designs of the individual standard departments must be considered in the context of whole hospitals with a certain predetermined pattern, and the departments themselves must obey the same 'rules of the game' as the whole hospital. Often to achieve the ideal solution and obey the rules, planning solutions must be evolved which considered separately may not be valid, but in the context of the whole hospital produce a valid solution. These for instance may involve the provision of two-level X-ray and operating departments which in themselves might be slightly less economical in terms of capital and revenue consequences but when considered in the context of the whole hospital produce better economic solutions and better inter-departmental relationships. Once the relationship of the standard department communication pattern has been identified the departments themselves must be rationalized. The first step is to determine incremental sizes of each department in terms of throughput. This would be reflected in terms of out-patient departments ranging from ten to thirty consulting rooms, theatre suites ranging from say four to twelve operating theatres, etc. There is also a broad band of inter-departmental size relationships which shows for example that although there is no direct relationship between the size of the out-patient departments and the size of the theatres, generally the larger the out-patient department the larger the theatres. The 'rules of the game' therefore need not allow for a very small out-patient department to be associated with a very large theatre suite. If we can determine the range of incremental sizes of all departments and establish dimensional relationships between them (possibly in terms of the span of the building), then assembling these standardized departments to form a unique solution seems feasible. This approach also makes it possible to stack even on a low rise development, a solution not often possible in orthodox hospital planning, with departments one above the other.

It is at this stage that the participation of regional hospital boards is essential; so that departmental designs shall be compatible with each other and nationally acceptable, a far higher than usual design commitment is necessary. Multidisciplinary teams from eight participating RHBs are currently working on these individual departments within the over-all guidance of DHSS, on planning 'rules of the

game', and the dimensional and constructional co-ordination. The rules governing the pattern of growth of each department are predetermined and the whole exercise is roughly analogous to a three-dimensional chess game using a board 15·3 m square on 4·2 m vertically.

In addition to the study of the various departments the HARNESS itself, i.e. the communication network of a hospital, must be carefully analysed not only in its horizontal movement but also in the vertical plane. This involves careful consideration of the positioning of lifts, ramps, conveyers, and also, and probably even more important, the parallel distribution system of distribution of engineering services. Whether these services can follow the same pattern of movement within the building, whether this pattern is sufficiently strongly defined in the engineering services is highly relevant and may lead us to consider unorthodox engineering solutions, such as, for example, decentralized secondary service points and boiler-houses. The work of analysis and design of the harness itself and its associated engineering work is the responsibility of a DHSS design team.

In association with the University of Cambridge we have produced a feasibility study which shows how a comprehensive suite of computer programmes could be used in the design and evaluation of these 'HARNESS' hospitals. The purpose of such a system is two-fold. First, it enables designer and decision-makers rapidly to test out the functions and cost implications of alternative layouts in terms of a given brief, or of changes in the brief, with respect to a given design. Secondly, it becomes possible to scan a number of feasible options and to arrive at a sound design based on prior knowledge of the hospital's performance. Both ways the system aims to effect beneficial economies.

The methods are intended to enhance the designer's skill rather than to exclude his judgement. They always have manual counterparts and it is the interaction between these two complementary processes that will lead to the production of good design solutions. It is essential to understand that at this stage the designer is able to superimpose his own assessment on the automatic mechanisms at any stage of the design development.

These methods will give the hospital design team the following advantages:

1. The ability to explore in depth various layout alternatives on a particular site.

2. The rapid evaluation of these alternative design concepts in terms that are readily understood.

3. The ability to monitor the costs of alternative solutions throughout hospital development.

4. The simulation of the effects of phasing on the development of a hospital.

5. The ability to react rapidly to modifications in the hospital brief resulting from government policy and advances in medicine and management at any stage of the hospital's design, construction, or use.

6. The ability to investigate the effects of internal conversion of hospital departments.

7. The availability of a quantified prediction of the hospital's performance prior to construction in terms of convenience, environment, and costs.

If these methods of tackling standardization are feasible, and current work goes little further than attempting to prove the practicability of such an approach, then the long-term implications must be considered. Once standardization is embarked upon nationally there is no going back and the implications are constant updating and reappraisal of all standard solutions. We must be prepared to commit a major portion of our professional skills to this task for the foreseeable future.

It would be pointless to apply these efforts to the designing process unless similar and co-ordinated steps were taken concerning the processing of the information necessary to get the building on the ground. The communication of information remains one of the major problems within the building industry and seems very susceptible to a systems analysis approach. The CUBITH method consists of six basic subsystems within a total system and comprises briefing, designing, production, material, construction, commissioning, and evaluation subsystems. These subsystems presume the construction of a data bank consisting of a series of data bases which will be constantly updated. Our present efforts will concentrate on the three major subsystems governing the production material and construc-

tion processes and will apply these to the HARNESS project. The seven RHB design teams engaged in the HARNESS exercise are working to the CUBITH format and as the information is produced it is fed into the appropriate data base. Inherent in the HARNESS exercise is the updating of the individual standard department designs and this is only possible using the computer-aided techniques and having a data base available. At the Mark I stage the designs are being prepared manually but the various activities are abstracted and fed into the activity data base. We are well aware of the old computer maxim 'rubbish in, rubbish out' and the Department is monitoring the RHB's design teams, not only to ensure compatibility but to ensure the highest quality of the design material.

The 'proof of the pudding' will be our first HARNESS Development Project at Dudley for the Birmingham Regional Hospital Board. It is early days to come to any firm conclusions on the HARNESS/CUBITH exercise, but first indications are that the designs being produced are at least as good as the best produced by conventional methods and show every sign of maintaining the country's international lead in the field of hospital planning.

22. Public Health Laboratory Service Research

SIR JAMES HOWIE
Director, Public Health Laboratory Service

'To-day's research is to-morrow's routine.' This objective is not attained automatically. Indeed, one of the common criticisms of the British use of research is the slowness with which discoveries are applied in practice. There are often difficulties, however, in applying new or even old knowledge to practical situations; and these difficulties will remain unless deliberate efforts are made to overcome them. For example, the knowledge that viruses may be grown in tissue culture did not instantly lead to active immunization against poliomyelitis although it made that advance possible. Before a vaccine could be generally employed for this purpose it was necessary to ensure that there was a safe way of killing or attenuating the polio virus; that potentially harmful contaminants of the tissue cultures could be excluded or controlled; that the population to be immunized would respond satisfactorily; and that the consequences of any break in the safety arrangements would be detected quickly enough to ensure that its effects were limited.

ROUTINE WORK AND INVESTIGATION

In co-operating with others concerned in tackling problems of the kind described, the Public Health Laboratory Service (PHLS) is an essential link between the backroom boy and the fieldworker. Its function is to make the laboratory examinations needed to provide a continuous picture of the communicable microbial diseases of the country and—so far as possible—of the countries from which infection may spread to our own. These diseases must be accurately

defined by identifying the agents that cause them, by continuously seeking out and recording their whereabouts, and by investigating what really matters in promoting or limiting their spread. On the basis of such investigations, the PHLS strives to be able to offer good and specific advice to the central and local health authorities, upon whom the responsibility rests for controlling and preventing communicable diseases.

To be useful, the advice offered must be both practicable and specific; otherwise it will not influence real situations in the field. Hence it is essential that the PHLS should be in touch with all who work in the field; and this is ensured by provision of a free routine diagnostic laboratory service in microbiology for local health authorities and family doctors, and for a number of hospitals by agreed cost-sharing arrangements. The routine service, however, is not an end in itself, useful and welcome as it is. Rather, it provides the sure point of contact with the field which alone can guarantee that the PHLS directs its research effort in the most productive way. Coming straight from the field, the questions that need to be investigated are real to those who ask them. Going straight back to the field, the proposed solutions must be practicable and specific, or they will be politely disregarded. Obviously, therefore, the research and investigative role of the PHLS is every bit as important as its function of providing a routine diagnostic laboratory service. Indeed, the main point about the routine service is that it must be maintained at a high enough level technically to be useful, not only for diagnosing and treating the infections of individual patients, but also for typing the relevant microbes whenever possible so that the epidemiological situation may be properly assessed. This means that the day-to-day work often needs to be more elaborately done than would suffice for routine diagnosis alone. Inquiries made by the laboratory staff must often go back beyond the infected patient to the sources of his infection; reports need to be followed up personally to ensure that their implications are fully understood.

UNFORESEEABLE PROBLEMS AND OPPORTUNITIES

All the time, members of the PHLS are on the lookout for important new questions arising from the field and for possibly important new answers coming forward from basic research. Obviously both the important new questions and the possible new answers often appear

without due notice. In particular they cannot be relied upon to appear at the right moment in the financial year to ensure that they are provided for in next year's budget. Moreover, some opportunities for important investigations must be grasped immediately either because the chance of doing so may be unique and temporary or because the problem is so urgent that delay is inadmissible. In these circumstances the PHLS gratefully acknowledges the help it has received from the research funds at the disposal of the Department of Health and Social Security. In other situations, a necessary investigation may obviously need to go very far beyond anything that could be rated as merely an elaboration of a routine service; and it may have to continue for a number of years before its usefulness can be fully assessed. In this category of work also, the research funds of the Department have assisted the PHLS to undertake in a proper way the tasks for which it was designed.

EXAMPLES

The listed enterprises supported by research funds tell their own story so far as current events are concerned. A short account of four examples may best illustrate the position.

Rubella diagnosis. During 1964 it became evident that the virus of rubella (German measles) could be grown in tissue culture and that antibody to the virus could be measured in the blood serum. These findings, if they could be taken into the field, would allow a service to be offered to doctors in charge of pregnant women who might have reason to fear that their unborn infants might later be born with deformities as a result of maternal infection with rubella. The value of such a service would lie in the immediate relief of anxiety that the doctor could bring by assuring a woman either that she had not been exposed to rubella or that she was already immune to it. In a few days, instead of after seven to nine months of anxious waiting, more than four-fifths of the mothers possibly at risk could be given full reassurance. If the tests established that the woman was at risk, her doctor, on equally sure grounds, could discuss with the mother whether her pregnancy should be terminated. But could a general service be realistically offered? The Virus Reference Laboratory of the PHLS at Colindale could do the necessary tests, but could other PHLS laboratories take them on? If not, the potential service would

be available in only a few favoured parts of the country. With the help of a grant from research funds to provide the necessary additional staff and equipment, the feasibility of doing these tests was first explored in six PHLS laboratories. By close collaboration, including visits and exchanges of material, and with the help of the Standards Laboratory at Colindale, the six laboratories carried out the test work successfully; and a general service became possible. The test is now done in 41 of the 62 PHLS regional and area laboratories.

Two important new observations came from extending this service: that close contact with an infected patient in the home rather than a short contact during a single meeting was what most often produced maternal infection; and that immunoglobulin, at least in the doses used, could not be relied upon to prevent infection of a woman exposed to risk. Details of this work were published (1).

Laminar-flow ventilation. With ever more elaborate clinical procedures, such as organ and tissue transplantation, and advanced measures to destroy tumour cells, more and more patients will need to be specially protected against the risks of acquiring infection in hospitals. This is not an easy problem to tackle, as is shown by persistence of the problem of hospital infection despite a great deal of work during the past twenty years. A new system, laminar-flow ventilation, offers the possibility of nursing patients in a room in which all the air flows in one direction. Both the direction and the rate of air-flow may be controlled. With the support of research funds and the collaboration of hospital colleagues, the PHLS undertook to assess the possible benefits that might result. A great deal of time-consuming and difficult work was required to establish base-line information. It has been established, however, that it is practicable to nurse severely ill patients in unidirectional air-flow and that this results in a great reduction of their exposure to airborne microbes, particularly of certain groups. Some kinds of infection, however, continue to reach the patients; and it is necessary to continue the work to examine the influence of nursing methods and certain added precautions that could reduce the spread of infection by contact.

Surveillance of vaccines. Infectious diseases have been reduced by improvements in hygiene, chemotherapy, and active immunization.

The beneficial effects of active immunization are well illustrated by the vast reductions, amounting almost to eradication, in the incidence of diphtheria and poliomyelitis and in the very much reduced danger from smallpox. Whooping-cough (pertussis) has also been much reduced, but not so reliably or effectively as had been hoped; and influenza remains a standing menace and challenge.

In 1966, the PHLS set up a working party to study the current status of active immunization against pertussis. This work was supported by many local authority health departments and by a number of individual workers in university departments and research institutes. After an enormous amount of field and laboratory work and a thorough analysis of the results, it emerged that a substantial amount of pertussis vaccine manufactured before 1966 gave rather a poor rate of protection: 26 per cent, instead of around 80 per cent or better which had been expected on the basis of earlier trials. Publication of this work (2) stimulated much argument and debate as well as renewed investigation at all levels. Obviously the matter could not be left where it was. Now the PHLS has set up an arrangement to monitor continuously the effects of various modifications of pertussis vaccines which have been and will be introduced. This necessary and important work is supported by a grant from departmental research funds.

At the same time, it has been accepted that a systematic assessment of influenza vaccines is required. Influenza vaccines certainly confer protection upon some individuals in some circumstances; but we still have not had a properly controlled trial on a sufficient scale to assess the full possibilities for the community either of current influenza vaccines or modifications which are constantly being introduced. Despite the difficult nature of the trial—much more difficult than that with pertussis vaccine—the PHLS has decided to undertake it. Nobody is able to predict how long it will have to continue in order to produce clear answers. Nature does not send influenza epidemics at regular intervals and they do not always involve, at exactly the optimum time, the areas where trials are in progress. However, this is obviously an investigation of such importance, complexity, and dimension that its support from special funds is essential if the PHLS is to undertake it.

Developments in the study of hepatitis. Fortunately there has at last been some progress in the study of viral hepatitis. During a search for

serum iso-antigens in isolated populations an antigen was found in the serum of an Australian aborigine which reacted in immunodiffusion tests with indicator sera from massively transfused individuals. In these persons the repeated stimuli could be expected to induce the formation of a variety of antibodies. This antigen was then shown to be present in varying degree in the serum of healthy persons from different countries, being more frequent in tropical areas, and an association with virus hepatitis was also observed. From its origin it has been called Australia or Au antigen. In separate studies by similar methods an antigen, named the SH antigen, was detected in the blood of patients with post-transfusion or serum hepatitis. Finally it was established that the two antigens were identical. The methods of antigen detection include the immunodiffusion technique originally used, complement fixation, which is more sensitive but requires more of the indicator serum, and electron microscopy in which the antigen deposited by high-speed centrifugation is negatively stained. A problem hampering investigators particularly in this country has been a shortage of human indicator serum. Attempts to overcome this by the preparation of antiserum in animals are in progress but the antigen does not appear to act as a powerful stimulus. Nor, despite its size of 160–200 Å measured by electron microscopy, is the antigen considered to be an infectious virus particle, though its presence is closely linked with infection.

The antigen is mainly associated with serum or post-transfusion hepatitis but has been reported present in some instances of sporadic hepatitis with no history of any form of inoculation. Characteristically it appears during the late incubation period, persists during the acute phase of illness, and disappears during convalescence though this is unrelated to the presence of specific antibody. In some healthy carriers who seem immunologically incapable of dealing with it, the antigen has been found to persist for many years, an obvious danger in persons who act as blood donors. In persons with chronic active hepatitis or with some immunological deficiency associated with suppressive drugs the antigen may also be found to persist for years, again a danger to all close contacts.

This accumulation of information has made the study of the many problems of hepatitis hopeful. With help from research grants, various lines of work are now being undertaken within the Service.

Obviously, much remains to be done. In particular, four possibilities are currently under discussion:

1. To provide reference centres to which problems may be referred from other laboratories in the PHLS, from the blood transfusion centres, and perhaps also from hospitals.

2. To undertake survey work, e.g. in dialysis units and mental hospitals.

3. To assess and develop new techniques in the hepatitis field.

4. To provide a diagnostic service, especially for infectious disease hospitals.

These new commitments, if it should prove possible to undertake some or all of them, represent a major and very difficult new development which can be contemplated only because of the great importance of the work and the possibility that support for it may be available from research funds.

These examples obviously represent only a small sample to show different ways in which the investigative work of the PHLS is supported by research funds. This approach to financing the investigative work of the PHLS has the advantage of flexibility. When a new problem or a new opportunity arises unforeseen—as is usual and inevitable if the new element is genuinely new—it is convenient to be able to appeal to a source of funds outside the normal budget, which is set up well in advance and is necessarily based upon known and foreseeable needs. This means that the funds required for the investigative work are accurately—and therefore economically—allocated *ad hoc* when the requirements are known. Difficulty arises, however, if the investigation must be continued for a longer period than the grant can be made available.

Apart from this, the PHLS acknowledges gratefully the support which it has received from departmental research funds in its efforts to develop and show how to apply new knowledge to the solution of practical day-to-day problems in the control of communicable microbial diseases.

REFERENCES

1. (1970). 'Studies of the effect of immunoglobulin on Rubella in pregnancy'. Report of a PHLS Working Party. *Br. med. J.* **2**, 497–500.

2. (1969). 'Efficacy of Whooping Cough Vaccine used in the U.K. before 1966', Preliminary Report by a PHLS Whooping Cough Committee and Working Party, Ibid. **4**, 329-33.

23. Locally Organized Research Scheme

R. H. L. COHEN

The scheme for locally organized research in England and Wales was started in 1958/9 as the second stage of larger arrangements for encouraging clinical research which had included earlier the setting-up of a special Clinical Research Board as part of the MRC. These arrangements followed recommendations from a joint subcommittee of the MRC and the Standing Medical Advisory Committee of the Ministry of Health in a report on *Clinical Research in Relation to the National Health Service* which was published in 1953 and was to have a far-reaching effect on the development of clinical research. It is against the background of this report that the purpose of the scheme for locally organized research, and its place in the organization of clinical research as a whole, can best be judged.

The report noted three main requirements if clinical research was to be developed with confidence on a scale commensurate with the opportunities:

1. The need for a central organization for promoting clinical research at the national level.

2. The need for a scheme of 'decentralized' research.

3. The need to provide conditions in which careers in clinical research would be equated with careers in the NHS and the opportunity created for free interchange of staff.

The responsibilities proposed for the central organization under the MRC, which would have available to it the advice of the Clinical Research Board, were:

1. To advise on the spending of funds provided by government.

2. To deal with investigations and field researches extending beyond regional boundaries or beyond the resources or outside the scope of local bodies.

3. To encourage research in fields not hitherto adequately covered.

4. To collect, collate, and distribute information so as to help in reducing the time-lag between discoveries and their application, and to avoid unintentional reduplication of investigations.

5. To supervise an organization providing careers in clinical research in association with the NHS.

Complementary to the activities of the central organization there was to be a scheme of 'decentralized' research at the level of regional hospital boards and boards of governors; this would be financed by the Ministry of Health from NHS funds but should be as far as possible free from detailed supervision. The main purposes of the scheme would be:

To foster the research spirit in medicine which is demanded by the highest standards of clinical practice.

To facilitate the discovery and encouragement of local talent.

Thus, the support of those making a career in research or of the continuing programmes of established research departments would remain the responsibility of the universities and the central research organization. The main aim of the decentralized scheme would be to widen the opportunities for modestly worthwhile work throughout the health service as a whole by providing an easily accessible source of support for specific minor and usually short-term projects arising from and closely related to day-to-day clinical practice. In operating the scheme boards were to be advised by specially appointed local research committees set up after consultation, and in agreement, with the university or medical school with which they were associated.

Finance is allocated annually by the Department (but with as firm an assurance as possible that a regular amount of income will be available over a period of years), from funds provided specifically by the exchequer against estimates from boards which set out continuing and proposed new work. In the spirit of the scheme no attempt is made centrally to assess the scientific merits of projects—this is the responsibility of the local research committees—but in making the allocations, within the total sum available for distribution,

the Department does take account of the effectiveness of the arrangements for local administration, the rate of development of the activity, and the availability to the board of other resources. Work beyond the scope of the scheme is referred to the MRC. In practice it has usually been possible to allocate to regional hospital boards, which have small non-exchequer resources, the whole or the greater part of the estimated expenditure on their programmes whereas the wealthier teaching hospitals are expected, and are content, to bear the major part of theirs from trust funds. The scheme has thus become the mainstay of research in the regional hospital boards and an important subsidiary source of support in the teaching hospitals; at present about half the money is allocated to the fifteen regional hospital boards and about half to the thirty-six boards of governors.

The scheme began in a very small way. In 1958/9, its first year, only nine regional hospital boards and three boards of governors participated; and the total expenditure was £35,000. Now all regional hospital boards and boards of governors take part and allocations in 1970/1 for England and Wales have risen to £935,000. Expenditure from boards' trust funds is probably still somewhat higher but is almost all concentrated in a very few hospitals.

In its earlier years, despite the original report's emphasis on the importance of field studies in epidemiology and social medicine and of observations in general practice, the scheme was almost entirely concerned with research in hospital. This is still so to a very large extent but since 1966 the local research committees have, to varying degrees, given active encouragement to workers in general practice and local health authorities to undertake research. The scheme is not limited to strictly clinical research and is open to non-medically qualified workers.

It seems to be generally agreed that the scheme is widely appreciated and fulfilling a real need. There is also good evidence that the standard of projects has steadily improved. All this is due to the enthusiasm of the local research committees, many of which have interpreted their responsibilities as going far beyond those expected of the conventional grant-giving body. More and more, by such means as interviewing applicants, visiting outlying hospitals, organizing symposia, and arranging for specialized help from academic departments they have succeeded in establishing the wide personal contacts which are the best encouragement to the young and untried worker in research.

A few regional hospital boards have appointed recently retired professors to visit hospitals and give advice on research. In the future, with the increasing development of postgraduate medical education the postgraduate medical centre will no doubt become the main stimulus and focus of local research activity.

The scheme seems therefore to have developed on sound lines. Nevertheless it has been in operation for some thirteen years and is now costing substantial sums of money; furthermore, there have been many changes in the medical scene since it started. During the same period, support for centrally organized clinical research has also increased, culminating in the recent opening by the MRC of the first phase of their Clinical Research Centre which is integrated with a new district hospital at Northwick Park, London. It may therefore be timely to look again at the purpose and organization of the decentralized research scheme and to review the balance between centralization and decentralization in the light of experience since the 1953 report. To this end the Department has opened discussion with the MRC about the desirability of examining, in the not too distant future, the ways in which clinical research might best be promoted.

Part III

List of current activities

EDITED BY L. BEST

List of current activities

Foreword

The health and welfare research and development activities currently supported by the Department, on its extramural programme, are listed in three sections, namely:

A short explanatory note prefaces each section.

The entries are arranged, within each subsection, in alphabetical order of universities or other organizations on which the research is based. They consist of the name of the university, etc., and the academic department, where appropriate; the name of the director(s); a short description of the work; the period supported and the approved expenditure from departmental funds.[1] A subject index is given on pp. 293–5, and a list of personal names on pp. 297–300.

References to publications are given in one list. The entries are limited to: periods in which support was given by the Department; work on the subjects for which support is given; and scientific or professional journals or books. Thus writings 'in press', publications on

1. Except that in the case of the eight research units (pp. 229–32) the current contract period and support in the current year are given.

the development under other auspices of concepts and methods used in the research listed, records of conferences and contributions to general books are not included. Further, in the case of a number of the research units (pp. 279–82) the entries are not complete, even within the stated limits, but are given as a useful indication of the range of work covered. Full details of references should be sought from the directors.

There are, in all, some 260 separate projects and programmes of work and the reader will appreciate that within the scope of an article of this scale it is not practicable to give full particulars of the objectives and other features of these separate schemes. We are conscious that the short descriptions given are in many cases insufficiently informative, and in some may be misleading. It is planned to produce a fuller catalogue, which will provide information in more detail of the aims, methods, financial arrangements, published material, and other features of the activities.

L. BEST

1. Medical, social, and operational research

The activities in this section are shown in four categories: research units, medical research programmes and projects, social research programmes and projects, and operational programmes and projects.

The research 'units' are multidisciplinary groups working under a formal agreement with the Department in an area broadly indicated by their title. Support for them is related to group resources, rather than to specific projects. Agreements usually run for periods of seven years. The programmes of work and the budgets needed to support them are reviewed regularly by an associated advisory committee. There are currently eight such 'units', but the programmes listed in the other categories include a number of centres where the formation of a 'unit' is under consideration.

The 'programmes' consist of contemporaneous or sequential research projects on the same broad theme, under the same director. The entries for a particular individual may consist of a number of separately approved and costed projects; of support for a general programme, such as 'studies of services for the mentally handicapped', in which case finance may comprise a sum for basic resources together with the cost of projects as they are approved; of

contributory finance for work undertaken in collaboration with the MRC or other organization; or of initial support for basic resources to facilitate the development of a programme of research or of a 'unit'.

'Projects' in the context of this list are single pieces of research with a defined objective and method—normally, but not necessarily, of not more than five years' duration.

Much of the work listed variously as medical, social, or operational research is, like that of the 'units', interdisciplinary in character, and in some cases the classifications are artificial. Generally the following broad distinctions apply: (*a*) Medical research includes both clinical and social medicine. All activities whose director is a doctor in medicine are listed in the medical subdivision, though some are repeated in other subdivisions. (*b*) The activities classed as 'social' are mainly, but not exclusively, those concerned with the services to be administered by the Social Service Departments created under the Local Authority Social Services Act, 1970. (*c*) The operational research activities are those whose main concern is with the role and use of manpower or with the application of management aids and techniques to health care problems.

RESEARCH UNITS

1. *University of Birmingham, Department of Pathological Studies*

PROFESSOR T. P. WHITEHEAD

The Wolfson Laboratories

These research laboratories are being established as a part of the new United Birmingham Hospital and Medical School development, with the purpose of undertaking research, evaluation, and trials on matters concerning pathology of potential interest to the NHS. Financial support for the building is provided by the Wolfson Foundation and for the equipment and running costs mainly by the Department. An advisory committee with representatives of the Department, the University, and the hospitals advises on the strategy and programme of work.

Term of present contract: 1969–76

Support in 1970: £33,500, *plus equipment:* £24,000

See also 1003

2. *Brunel University, School of Social Sciences*

PROFESSOR E. JAQUES

The Hospital Organization Research Unit

The Unit provides an organizational analytical resource to hospital authorities seeking its help; it is undertaking studies in the North-west Metropolitan Regional Hospital Board, five hospital management committees, and three London teaching hospitals. It provides a large development programme in management structure for the Regional Hospital Board through research projects and associated staff development conferences. Brunel has two related research teams at present financed by the Home Office. One, a community development team, has started work on local authority health and social services policy and organization. The other, on the organization and management of the children's services, is about to include studies and staff conferences within the social services for which DHSS is responsible, and the Department will be contributing to the cost.

Term of present contract: 1968–73

Support in 1970: £20,000

---

3. *University of Exeter*

PROFESSORS J. R. ASHFORD and N. G. PEARSON

The Institute of Biometry and Community Medicine

The Unit was established to develop and extend an existing programme in the fields of epidemiology and in the medical applications of statistics, computing, and operational research, in the population of Devon and Exeter and elsewhere. It consists of three divisions—epidemiology, numerical science, and operational research—though all research is integrated. The main current studies are the Exeter Community Health Project; a wide range of studies of infant mortality and morbidity; of disability; of services and financial and other support provided for the elderly; of the evaluation of coronary care trials; of medical administration; work on modelling health care systems; epidemiological studies of blood parameters. The unit also provides advisory services to local administration in many aspects of medical care, for example on a mobile surgery provided by the Nuffield Provincial Hospitals Trust, for operation by GPs in a rural area, and the NHS Computer Project in Exeter.

Term of present contract: 1968–75

Support in 1970: £65,600 *with additional support from the Nuffield Provincial Hospitals Trust and for accommodation by the South Western RHB and the DHSS*

---

4. *University of London, Institute of Psychiatry*

DR J. G. EDWARDS

The Addiction Research Unit

The Unit was formed in 1966 on the merger of the Alcoholism Research Group, supported by the Nuffield Foundation, with a newly formed Drug

Addiction Group, built and supported by the Ministry of Health. In 1969 a group concerned with smoking was added. The MRC provided the funds for the last and also for specific projects in all these fields. A new agreement with the MRC and the Department jointly provides for research into epidemiological, behavioural science, and treatment aspects of all varieties of chemical abuse. Research current at the time of the last report (January 1971) included four projects in alcoholism, nine in drug addiction, and four in smoking; while members of the unit are involved individually in a number of community projects, including the evaluation of hostels for withdrawn drug addicts (see development item 1024).

Term of present contract: 1970–7

Support in 1970: £50,000 *with further support from the MRC*

---

5. *University of London, Institute of Psychiatry*

PROFESSOR T. C. N. GIBBENS and DR T. G. TENNENT

The Special Hospitals Research Unit

This Unit was set up by the Department in 1969 to carry out medical, behavioural, and social scientific or biological research in the three special psychiatric hospitals at Broadmoor, Rampton, and Moss Side. The work is relevant to the description, explanation, management, or modification of antisocial behaviour associated with psycho-pathology. Current work includes the setting up of a research and intelligence organization; demographic studies—primary descriptive work and a cohort study; specific medical and social projects; and also the co-ordination of research activities of special hospitals staff.

Established 1969

Support in 1970: £25,000

See also 89

---

6. *University of Newcastle upon Tyne, Medical School*

PROFESSOR D. J. NEWELL and DR J. H. WALKER

The Medical Care Research Unit

The Unit was set up in 1969 to undertake research into the provision, organization, and effects of medical care. Current activities include studies designed to lead to the clearer definition of interest and responsibility between general practices and hospitals in accident and emergency, paediatrics, chest disease, and dermatology; a study of child health services seeking to identify duplication, failure of communication, and unrendered service; a social survey associated with prospective studies of spina bifida; mortality as an index to morbidity; analysis and interpretation of hospital activity data; the evaluation of treatment of low back pain (see also 92).

Term of present contract: 1969–76

Support in 1970: £17,000 *with support for accommodation*

7. *Northwick Park Hospital, Clinical Research Centre*

DR T. W. MEADE

The Joint MRC/DHSS Epidemiology and Medical Care Unit

This is a Unit in the process of establishment, which will be undertaking studies in the aetiology of disease and in medical care. The Director and Advisory Committee for the unit have recently been appointed. The terms of reference of the Advisory Committee are to assist the Director in planning and developing the research programme of the Unit and in maintaining an appropriate balance between various aspects of the programme, having regard to the particular interests of the Council and the Department respectively.

1970

Terms under discussion

---

8. *St Thomas's Hospital Medical School, Department of Clinical Epidemiology and Social Medicine*

PROFESSOR W. W. HOLLAND

The Social Medicine and Health Services Research Unit

The Unit was established in 1968, following programme support over some years, to study the medical and social needs of defined population groups, the implications of the organization of health services on need, demand, and utilization of services and the epidemiology of disease in the United Kingdom. Current work includes the Lambeth Health Surveys, studying prevalence and incidence of various common conditions in relationship to the need for medical care; of medical demand, method of operation, assessment of teaching in general medical practice; of early diagnosis and surveillance of disease; controlled trials of treatment of raised blood pressure; evaluation, in connection with two new hospitals and local health and general medical services of the influence of new procedures and changes in organization on the quality, cost and type of medical care received; assessment of pattern of nutrition in schoolchildren.

Term of present contract: 1970–7

Support in 1970: £110,000

MEDICAL RESEARCH PROGRAMMES

9. *University of Birmingham Medical School, Department of Social Medicine*

PROFESSORS T. MCKEOWN and E. G. KNOX

Support for establishment of Centre for Health Services Research.

Support in 1971: £17,000 (*with capital support from the Nuffield Provincial Hospitals Trust and from the DHSS*)

10. *University of Liverpool, Department of Psychiatry*

PROFESSOR A. MUNRO

Investigation of the metabolism of psychiatric patients with special reference to pink spot excretion in schizophrenia; the development of computer programs to analyse data from the human automated open field and from the computer-assisted psychiatric system (CAPS). Further development of a portable laboratory to facilitate these projects.

Approved support 1970–2: £22,575

---

11. *University of London, Guy's Hospital Medical and Dental Schools, Department of Community Medicine*

DR J. A. D. ANDERSON

Studies in (i) methods and organization of community health teams and of the community hospital; (ii) aspects of medical management; (iii) the role of the consultant in management.

Approved support 1968–73: i. £40,000; ii. £3,000; iii. £2,900

---

12. *University of London, Guy's Hospital Medical School, Department of Medicine*

PROFESSOR W. J. H. BUTTERFIELD

Studies of methods of evaluating hospital care.

Approved support 1970: £6,400

University of Kent

DR M. D. WARREN

Health and Social Service research programme.

See 97 for details

---

13. *University of London, London Hospital Medical College Dental School*

PROFESSOR G. L. SLACK (i)

The Office of Population Censuses and Surveys, Survey Division

MR P. G. GRAY (ii)

Investigation into dental health and attitudes to dentistry of the adult population in England and Wales: (i) dental examinations; (ii) dental interviews

Approved support 1967–70: i. £31,108; ii. *no costs borne directly by the Department*

14. *University of London, London Hospital Medical College Dental School*

PROFESSORS G. L. SLACK, H. ALLRED, and R. DUCKWORTH

Experimental Dental Care Unit and studies to determine methods of training dental health teams and test their value.

Approved support 1970–5: £140,000 (*provisional*)

---

15. *University of London, London School of Hygiene and Tropical Medicine, Department of Public Health*

PROFESSORS J. N. MORRIS and R. F. L. LOGAN

Studies of Health Service needs, resources and outcomes; related economic studies. Specific projects include a study of the 'interface' between hospital and community nursing services; the effects of low or falling hospital provision on health, the community services, etc.

Approved support 1969–72: £71,000

---

16. *University of London, London School of Hygiene and Tropical Medicine, Department of Public Health*

PROFESSOR J. N. MORRIS and DR J. M. G. WILSON

Chronic disease control study unit. Studies include: (i) collaborative study with West Sussex County Council and the University of Sussex of the acceptability of the irrigation pipette by women in their own homes (see 104); (ii) validation of screening tests for unreported disability in old people (in collaboration with the Caversham Centre and the London Borough of Camden); (iii) evaluation of the effect of cone biopsy on fertility and outcome of pregnancy.

Approved support 1970–3: £75,000

---

17. *University of London, London School of Hygiene and Tropical Medicine*

PROFESSOR J. C. WATERLOW

Programme of studies in nutrition to follow present DHSS studies.

Approved support 1970–2: £4,000

---

18. *University of London, Institute of Psychiatry*

PROFESSOR M. SHEPHERD

Psychiatric morbidity in general practice.

Approved support 1966–72: £36,000 (*provisional*)

19. *University of London, Institute of Psychiatry*

PROFESSOR J. K. WING

Development and analysis of psychiatric diseases registers for research and planning in Salford and Worcester. Studies of psychiatric and social services in Camberwell, including the Camberwell Reception Centre.

Approved support 1970–5: Estimate £29,000 *plus support for accommodation*

See also 25

---

20. *University of Manchester, Darbishire House Health Centre*

DR P. S. BYRNE

Development and evaluation of vocational training programme for GPs.

Approved support 1968–74: £58,525

See also 156 and 142

---

21. *University of Manchester, Department of Child Health*

PROFESSOR J. A. DAVIS

Community paediatrics—proposals being formulated.

Approved support 1971–6: £35,500

---

22. *University of Manchester, Department of Social and Preventive Medicine*

PROFESSOR E. ALWYN SMITH

Programme of studies:

i. Manchester Cervical Cytology Screening Project for evaluation of the effects of cytological screening and determination of the optimal interval for the screening of individual women.

ii. Programme of research based on register of psychiatric illness in Salford.

iii. Social casework associated with general medical practice.

iv. Community care of the mentally subnormal in Lancashire—an evaluation of local residential care and the effect of hostel placement, and other studies.

v. Programme of research in the field of public health nursing.

Approved support i. *1968–71:* £12,000; ii. *1969–72:* £14,500; iii. *1969–73:* £18,000; iv. *1966–71:* £25,000; v. *1970–3:* £17,000

i. See also 1022

---

23. *University of Manchester, Hester Adrian Research Centre*

DR P. MITTLER

The study of learning processes in the mentally handicapped.

Approved support 1970–2: £40,000

24. *Medical Research Council, Epidemiological Research Unit*

PROFESSOR A. L. COCHRANE

i. Studies on the treatment of varicose veins and allied work.

ii. Studies on the incidence and treatment of stroke in South Wales.

iii. Comparative study of chronic disease treated in out-patients and by GPs.

Approved support 1966–71: £27,000.

---

25. *Medical Research Council, Social Psychiatry Unit, University of London, Institute of Psychiatry*

PROFESSOR J. K. WING and DR LORNA G. WING

Evaluation of psychiatric services. Studies arising from the psychiatric diseases register for the London Borough of Camberwell.

Approved support 1965–75: £82,000

See also 19

---

26. *University of Newcastle upon Tyne, Department of Psychological Medicine*

PROFESSOR M. ROTH

Follow-up studies on two cohorts of elderly subjects. Ongoing studies include development of predictive indices for psychiatric illness; means of estimation of demand on community and institutional services for elderly; measurement of psychological functioning and personality characteristics; investigations into early stages of cerebral degenerative disease.

Approved support 1969–72: £18,000 (*provisional*)

See also 1040

---

27. *University of Nottingham, Department of Psychology, Blind Mobility Research Unit*

DR J. A. LEONARD

Development and assessment of means of increasing the mobility of the blind.

Approved support 1970–5: £37,500

---

28. *University of Nottingham, Medical School, Department of Community Health*

PROFFESSOR E. M. BACKETT

Initial support for a programme in the evaluation of medical care and in health service research.

Approved support 1970–1: £16,400

29. *University of Oxford, Department of the Regius Professor of Medicine, Health Services Evaluation Group: Community Hospital Programme*
PROFESSOR W. R. S. DOLL and DR A. E. BENNETT
Planning and evaluation of a new type of small hospital in the Oxford region and of an experiment in Oxford in integration of hospital and community services.
Approved support 1970–5: £84,000 (*provisional*)

---

30. *University of Oxford, Department of the Regius Professor of Medicine*
PROFESSOR W. R. S. DOLL and DR J. A. BALDWIN
Epidemiological studies based on record linkage data in the Oxford region (other support by the Nuffield Provincial Hospitals Trust).
Approved support 1970–8 (second phase): £150,000 (*provisional*)
See also 1041

---

31. *Royal College of General Practitioners, Research Committee*
DR D. L. CROMBIE
General Practitioner Research Unit undertaking experimental work and morbidity surveys and advising GPs in research.
Approved support 1965–75: £128,800

---

32. *University of Sheffield, Department of Preventive Medicine and Public Health*
PROFESSOR J. KNOWELDEN
Collaborative studies with Sheffield RHB of aspects of medical care in the region.
Approved support 1969–73: £11,230

---

33. *University of Southampton, Medical School*
Support for:
i. Establishment of a professorial unit in geriatrics (Professor of Geriatric Medicine: PROFESSOR M. R. P. HALL).
ii. Establishment of an experimental medical information unit in Wessex (Professor of Medical Information Science: PROFESSOR M. R. ALDERSON).
Approved support 1970–7: i. £50,000 (*provisional*); ii. £90,000 (*provisional*). *Both financed jointly with Wessex RHB*

MEDICAL RESEARCH PROJECTS

34. *United Cambridge Hospitals, Addenbrookes Hospital*
MR W. S. LEWIN and DR A. H. ROBERTS
Study of the long-term prognosis in severe closed head injury.
Approved support 1970–1: £9,850

35. *The Bethlem Royal Hospital; with DHSS Division SR2*
DR P. H. CONNELL
Study of heroin-dependent patients.
Approved support 1969–71: £5,776

36. *City of Birmingham Public Health Department*
Nutrition survey of schoolchildren in South-east Birmingham.
Approved support 1970–1: £19,085

37. *University of Birmingham Medical School; United Birmingham Hospitals; University of Aston in Birmingham*
PROFESSOR J. M. BISHOP, MR A. E. MARSTON, and PROFESSOR M. R. W. BROWN
Information system for the safe and efficient handling of drugs in hospital.
Approved support 1969–72: £13,850

Centre for the Study of Adolescence
DR M. LAUFER
Research into mental breakdown in adolescence.
See 107 for details

38. *Charing Cross Hospital*
PROFESSOR H. I. WINNER
Infection risks in an ultra-clean unit.
Approved support 1970–3: £4,890

39. *Chester Beatty Research Institute, Department of Cell Biology*
PROFESSOR E. J. AMBROSE
Pilot study of malignant cell recognition using plant agglutinins.
Approved support 1969–71: £3,800

40. *United Oxford Hospitals, The Churchill Hospital, Department of Clinical Cytology*
DR A. I. SPRIGGS and MR M. M. BODDINGTON
Varied interval of recall for cytological examination according to age.
Approved support 1968–71: £7,750

41. *Department of Health and Social Security with North-east Metropolitan Regional Hospital Board and Guy's Hospital*
Follow-up study of the feeding of old people in hospital.
Approved support 1969–70: £3,300

42. *University of Dundee, Department of Pharmacology and Therapeutics; University of Aberdeen, Department of Social Medicine*

PROFESSORS J. CROOKS and R. D. WEIR

Adverse drug reactions—screening of suspected drugs and side-effects in a defined population.

Approved support 1968–72: £6,450

---

43. *University of Edinburgh, Departments of Medicine and Social Medicine*

PROFESSORS K. W. DONALD and S. L. MORRISON

Community study of acute coronary heart attacks in Edinburgh.

Approved support 1966–70: £8,770 *with additional support from the Scottish Home and Health Department*

---

44. *University of Edinburgh, Departments of Medicine and Social Medicine*

PROFESSOR K. W. DONALD, DR M. F. OLIVER, and PROFESSOR S. L. MORRISON

Study of the relationship between angina of recent onset and acute coronary heart attacks.

Approved support 1970–4: £28,290, *additional support as for 43*

---

45. *Farnborough Hospital*

DR PATRICIA G. WALLIS

A records system for ante- and perinatal events.

Approved support 1966–70: £14,075

---

46. DR I. GREGG, London SW15

A prospective study carried out in general practice in association with the Roehampton Hospital into constitutional and environmental factors in the natural history of asthma and chronic bronchitis.

Approved support 1964–70: £8,450.

---

47. *Hammersmith and St Mark's Hospitals*

PROFESSOR J. P. SHILLINGFORD

Evaluation of a trial coronary care ambulance service.

Approved support 1970–2: £3,400

See also 1015

---

48. *Hammersmith and St Mark's Hospitals*

PROFESSOR A. P. WATERSON

Virological problems in connection with haemodialysis and renal transplantation.

Approved support 1970–2: £5,750

49. *Harperbury Hospital, Kennedy-Galton Centre*

DR L. S. PENROSE

Development of technique for prenatal diagnosis of mongolism.

Approved support 1971–3: £4,800

---

50. DR C. HODES, Boreham Wood, Herts.

Computer recording and assessment of screening procedures in general practice.

Approved support 1966–70: £4,580

---

51. *Heriot-Watt University, Department of Pharmacy*

PROFESSOR A. R. ROGERS and MR A. W. PATTERSON

Studies in drug prescribing: i. prescribing and dispensing—analysis of specific drugs; ii. prescribing patterns of a cohort of doctors.

Approved support 1970–1: preliminary study £7,000

University of Keele

DR H. H. GREENWOOD

Data-processing in general practice—patient profiles.

See 147 for details

---

52. *King's College Hospital (in association with Guy's Hospital and the Medical Officers of Health for Lambeth and Southwark)*

DR V. PARSONS

Screening project, centred on the Schools Medical Service, for renal disease. (Feasibility trial including an examination of methods and validation of the test.)

Approved support 1971: £7,000

---

53. *University of Leeds, Department of Paediatrics and Child Health*

PROFESSOR R. W. SMITHELLS

Nutrition—prenatal factors and their possible relationship to abnormalities of growth and development of the foetus and infant.

Approved support 1969–71: £4,740 (*support also from Action for the Crippled Child and Roche Products Ltd*)

---

54. *University of Liverpool, Department of Psychiatry*

DR P. LEY

Methods of improving communication between doctors and patients.

Approved support 1970–3: £15,800

55. *University of London, Institute of Child Health*

DR K. S. HOLT

Comparative study of whole population and selective population methods of examination for the detection of delayed and aberrant development.

Approved support 1970–5: £52,700

---

56. *University of London, Guy's Hospital Dental School*

PROFESSOR W. J. TULLEY

Research into dental problems of physically and mentally handicapped children.

Approved support 1968–72: £15,000

---

57. *University of London, Guy's Hospital Medical School, Department of Medicine*

DR H. KEEN and DR R. J. JARRETT

Evaluation of scheme for early discovery and treatment of diabetes, by follow-up and controlled trial in Bedford and London population groups.

Approved support 1966–72: £69,000

---

58. *The London Hospital, Cardiac Department; Medical Research Council's Social Medicine Unit*

PROFESSOR J. N. MORRIS and DR H. D. TUNSTALL PEDOE

Community register of heart attacks in Tower Hamlets with follow-up of return to work, for the World Health Organization.

Approved support 1970–3: £6,340

---

59. *University of London, Middlesex Hospital Medical School*

Smoking research project (secretarial support only).

Approved support 1969–70: £500

---

60. *University of London, Institute of Ophthalmology*

PROFESSOR E. S. PERKINS

Follow-up on a main survey in Bedford for glaucoma.

Approved support 1963–71: £13,600

---

61. *University of London, Institute of Psychiatry*

DR M. L. RUTTER, DR L. A. HERZOV, MR M. BERGER, and MR W. YULE

An evaluation of a behavioural approach to the treatment of autistic children.

Approved support 1970–3: £14,600

62. *University of London, Royal Postgraduate Medical School, Department of Chemical Pathology; Hammersmith Hospital, Institute of Obstetrics and Gynaecology*

PROFESSOR I. D. P. WOOTTON and DR G. ERICA WACHTEL

i. Combined screening operation for cervical cancer using biochemical and cytological methods in parallel.

ii. Study of the relationship of trichomonas vaginalis infection to cytological screening for carcinoma of the cervix.

Approved support 1967–71: £7,840

---

63. *University of London, Royal Postgraduate Medical School, Department of Surgery*

PROFESSOR R. SHACKMAN

Research in kidney preservation for transplantation.

Approved support 1970–2: £3,380

---

64. *University of London, Royal Postgraduate Medical School*

PROFESSOR J. S. CALNAN

Research into the diagnosis and prevention of deep vein thrombosis after surgical operation.

Approved support 1970–2: £10,515

---

65. *University of London, St Mary's Hospital Medical School*

DR G. A. ROSE

Community health study in the Paddington district.

Approved support 1969–71: £8,200

---

66. *University of London, St Mary's Hospital Medical School*

DR G. A. ROSE

A multi-factor prevention trial for ischaemic heart disease.

Approved support 1970–7: £161,000

---

67. DR JOYCE R. LUDLOW, Birchington, Kent

Comparative study of children suffering from Down's disease to observe the effect of various factors, including preschool stimulus and early institutionalization, upon their development.

Approved support 1970–2: £3,000

68. *University of Manchester, Department of Social and Preventive Medicine*

DR L. BARIC

The determinants of behaviour related to the aetiology of coronary artery disease.

Approved support 1970–2: £7,545

---

69. *Newcastle Regional Hospital Board*

DR G. MCCOULL

Aetiological classification and diagnosis of mental subnormality cases in the Newcastle region with inquiry into type of residence and occupation, factors indicating social incompetence, prematurity, and twinning, together with the incidence of certain secondary diagnostic factors.

Approved support 1966–71: £31,330

---

70. *Napsbury Hospital and Brunel University*

DR R. D. SCOTT

To predict by means of an interpersonal perception test which schizophrenics, on first admission, who were admitted from parental homes, will be able to return home after an acute illness and which are likely to remain in hospital or become serious problems in the community.

Approved support 1968–72: £10,780

---

71. *National Blood Transfusion Service, North London Blood Transfusion Centre*

DR T. E. CLEGHORN

The use of red cell stroma as antigen in immunization for anti-D immunoglobulin production.

Approved support 1970–3: £9,300

See also 1034

---

72. *National Blood Transfusion Service, Regional Blood Transfusion Centre, Manchester: Blood Transfusion Sub-Centre, Lancaster*

DR F. STRATTON; DR H. H. GUNSON

Research into the effects of immunization by small doses of red cells.

Approved support 1968–74: £10,800; £3,260 *equipment and revenue per annum from 1970*

See also 1034

---

73. *City and County of Newcastle upon Tyne, Health and Social Services Department*

DR W. B. SHAW

Nutrition survey of schoolchildren, including fatherless families.

Approved support 1969–71: £9,350

74. *Newcastle Regional Hospital Board*
Adverse Drug Reaction Bulletin
Approved support 1970: £440

75. *Newcastle Regional Hospital Board*
DR J. B. SELKON
Screening of schoolchildren for asymptomatic bacteriuria and the evaluation of treatment.
Approved support 1969–75: £24,650

76. *North Middlesex Hospital*
DR A. G. MEZEY
Study of clinical, psychological, and operational problems raised by the integration of psychiatry into the work of the district general hospital.
Approved support 1965–72: £13,075

77. *Office of Population Censuses and Surveys and Royal College of General Practitioners*
National Morbidity Study
Under discussion

78. *Oxford Regional Hospital Board*
MISS D. STAPLES
Research scholarship in clinical psychology.
Approved support 1970–3: £4,500

79. *United Birmingham Hospitals, Queen Elizabeth Hospital*
DR J. L. WHITBY
Computer data-processing techniques—application to hospital bacteriological laboratory.
Approved support 1967–71: £8,455

80. *United Oxford Hospitals, The Radcliffe Infirmary*
DR J. M. HOLT
Assessment of the therapeutic efficiency of hospital prescribing at the time of discharge from hospital.
Approved support 1970: £905

81. *Royal College of Obstetricians and Gynaecologists*
MR J. M. BRUDENELL and DR C. TAYLOR
Pre-invasive lesions of the uterine cervix.
Approved support 1964–72: £5,750

82. *Royal Devon and Exeter Hospital*

DR D. B. SHAW

Study of the prevalence, incidence, morbidity, and mortality of heart block and bradycardia in the Devon Clinical Area (population approximately 580,000).

Approved support 1971–4: £11,820

---

83. *Royal Marsden Hospital (Surrey Branch)*

DR H. E. M. KAY

Experiment to assess the use of plastic isolators for patients in cases where cross-infection would be a serious hazard.

Approved support 1966–70: £32,620

---

84. *Runwell Hospital*

DR A. A. ROBIN

Comparison of a psychiatric unit in a general hospital with a large psychiatric hospital.

Approved support 1966–70: £21,400

---

85. *St Ann's General Hospital, Infectious Diseases Unit; Coppets Wood Hospital*

DR G. D. W. MCKENDRICK and DR R. T. D. EMOND

An investigation into the incidence of cross-infection in isolation wards of different design.

Approved support 1968–73: £12,820

---

86. *St Bartholomew's Hospital, Bacteriology Department*

PROFESSOR R. A. SHOOTER

Research into cross-infection in a newly commissioned hospital (Greenwich).

Approved support 1969–72: £10,210

---

87. *St Christopher's Hospice*

DR CICELY M. S. SAUNDERS

i. Research into the control of chronic pain.

ii. Evaluation of an experimental domiciliary service for patients in the terminal stage of illness.

Approved support 1966–71: £29,050 (*plus* £11,877 *capital*)

88. *St Thomas's Hospital*

PROFESSOR P. RHODES and DR JOANNA SOUTH

Automatic data-processing of obstetric records by computer techniques.

Approved support 1968–71: £13,500

---

89. *Sheffield University, Centre for Human Genetics and Sub-Department of Medical Genetics*

DR C. E. BLANK

The relationship between chromosome abnormality and social deficiency: with particular regard to the incidence of XYY and XXY individuals in special security hospitals, prisons, and the general population.

Approved support 1967–71: £7,500

See also 5

---

90. *The Tavistock Centre*

DR C. MURRAY PARKES

The psychological reactions to limb amputations.

Approved support 1967–71: £11,670

Welsh National School of Medicine

DR K. M. LAURENCE, PROFESSOR K. RAWNSLEY, and DR E. H. HARE

Family and social problems of 4–8-year-old children suffering from spina bifida cystica.

See 124 for details

---

91. *University College Hospital Medical School*

DR I. LECK

Effects of a new health centre in Kentish Town. First stage.

Approved support 1970–1: £7,000

See also 98

---

92. *West Middlesex Hospital*

DR D. M. L. DORAN

Trial of manipulation in the treatment of low back pain (see 6 for evaluation).

Approved support 1969–71: £2,100

93. *Westminster Hospital*

MR C. E. DREW and DR C. J. GAVEY

Trial of the use of hyperbaric oxygen in the treatment of patients with acute myocardial infarction.

Approved support 1970–1: £7,380 (*plus* £2,250 *capital*)

94.

DR E. I. WILLIAMS, Bolton, Lancs.

Assessment of general health of patients in the over-75 age-group.

Approved support 1970–1: £150

SOCIAL RESEARCH PROGRAMMES

95. *University of Birmingham, Centre for Urban and Regional Studies*

PROFESSOR J. B. CULLINGWORTH

Studies of homelessness in London (directed by Professor Greve), of the impact of social change on the elderly, of the planning requirements for area health services, and of the social area analysis of urban areas.

Approved support 1968–73: £76,000 (*provisional*)

96. *Institute for Social Studies in Medical Care*

DR ANN CARTWRIGHT

Programme of studies on social aspects of medical care, including:

i. An evaluation of a transport service in general practice (see 1017).

ii. The acquisition and consumption of medicines.

iii. Care of the dying.

iv. Impact of birth control services.

Approved support 1967–72: £104,000 (*provisional*)

97. *University of Kent*

DR M. D. WARREN (Director Designate from June 1971)

Health and social service research programme concentrating initially on general medical practices and health centres. Following current project work.

Support approved to June 1978

98. *University of London, Social Research Unit, Bedford College*

PROFESSOR MARGOT JEFFERYS

Programme of social research including:

i. Inquiry into the need for social and medical services in the London Borough of Camden.

ii. Measurement of impaired physical function.

iii. Response to disability of sudden onset.

iv. Rehabilitation of male patients of working age.

v. Effects of a new health centre in Kentish Town.

Approved support:
i. £22,130 (*plus equivalent contribution from Camden*), *1965–70*; ii. £15,820, *1966–71*; iii. £12,760, *1970–1*; iv. £450, *1970*; v. £14,400, *1970–3*

v. See also 91

---

99. *University of London, Department of Child Development, Institute of Education*

PROFESSOR J. TIZARD

Programme of research in the up-bringing of handicapped and deprived children.

Approved support 1970–8: £80,000

---

100. *University of London, Institute of Education*

PROFESSOR J. TIZARD and DR A. KUSHLICK

Evaluation of experimental forms of residential care for the mentally subnormal in Wessex.

Approved support 1968–73: £8,500 (*cost shared with MRC*)

University of Manchester, Department of Social and Preventive Medicine

PROFESSOR ALWYN SMITH

Social casework associated with general medical practice. Community care of the mentally subnormal in Lancashire (see 22).

---

101. *University of Manchester, Institute of Science and Technology*

MR B. MOORES

i. Evaluation of an organization for the procurement and allocation of work for institutional industrial therapy.

ii. Support for two projects by postgraduate students in NHS subjects.

iii. Nursing deployment.

Approved support: i. *1970–1:* £1,720; ii. *1968–71:* £1,600; iii. *under discussion*

---

102. *National Children's Bureau*

DR M. L. KELLMER PRINGLE and MR R. DAVIE

Programme of studies of children with special needs in a family setting and in society; and of relevant services.

Approved support 1967–74: £240,000

103. *National Institute for Social Work Training*

MISS E. M. GOLDBERG

Organization and outcome of social work generally and for particular groups such as the elderly and the schizophrenic.

Approved support 1964–77: £230,000 (*provisional*)

University of Nottingham, Department of Psychology, Blind Mobility Research Unit

DR J. A. LEONARD

Development and assessment of means of increasing the mobility of the blind.

For details see 27

---

104. *University of Sussex, Centre for Social Research*

DR P. J. M. MCEWAN

Public reaction to new cytology methods (irrigation pipette) (see also 16).

Approved support 1969–72: £22,240

---

105. *Tavistock Institute of Human Relations, The Tavistock Centre*

DR E. J. MILLER

Geriatric hospital care: an action research study.

Approved support 1969–72: £24,520

---

106. *University College of Swansea, School of Social Studies*

PROFESSOR W. M. WILLIAMS

Studies in medical sociology, including prescribing practice of GPs, children in hospital, relationship between patient and doctor.

Approved support 1968–73: £102,500

The Bethlem Royal Hospital; with DHSS Division SR2

DR P. H. CONNELL

Study of heroin-dependent patients.

See 35 for details

SOCIAL RESEARCH PROJECTS

107. *Centre for the Study of Adolescence*

DR M. LAUFER

A study of the data collected at the Brent Consultation Centre (a walk-in service for young people).

Approved support 1970–1: £4,000

108. *Department of Health and Social Security*

PROFESSOR A. SORSBY and MRS R. ANN ABEL

Medical and social services in incipient blindness. A retrospective survey for Greater London in 1968.

Approved support 1969–70: £2,930

---

109. *County Council of Essex, Welfare Department*

MR W. E. BOYCE and MR S. M. TASNIM YAWAR

Development of services for old people. An inquiry into the provision of housing, health, welfare, and social services, and the extent of need expressed in six selected areas in the County of Essex.

Approved support 1970–1: £1,700

---

110. *University of Essex, Department of Sociology*

PROFESSOR P. TOWNSEND and MR W. B. JAEHNIG

Mentally handicapped children and their relationships with their families and the social services.

Approved support 1970–1: £5,100

---

111. *Greater London Council, Social Studies Division*

MISS B. M. SPAIN

Spina bifida:

i. Incidence and prevalence study in Greater London.

ii. Longitudinal study to investigate handicaps, problems, and use of services.

Approved support 1967–74: £24,617

---

112. *University of Keele, Department of Sociology*

DR A. BIGOT

The occurrence of 'apathy' among elderly people living in residential homes.

Approved support 1968–70: £750

---

113. *London Borough of Camden, Council of Social Services* (i); *Institute of Community Studies* (ii)

Neighbourhood officer in Camden:

i. Experiment.

ii. Evaluation.

Approved support: i. *1969:* £1,060; ii. *1969–71:* £4,560

114. *University of London, Birkbeck College*

PROFESSOR A. RODGER and MR P. W. W. CAVANAGH

Attitudes of hospital staff and patients (and possibly relations) to the introduction of new equipment—particularly Monitron.

Approved support 1969–71: £5,960

---

115. *University of London, Goldsmith's College, Department of Sociology; The Hospital for Sick Children*

MR R. A. PINKER

i. Expenses of part-time postgraduate students undertaking research of interest to the Department.

ii. Study of nursing professional education.

iii. Secondment of nurse tutor for ii.

Approved support 1970–2: i. £500 p.a.; ii. £1,060; iii. £4,000

---

116. *University of London, London School of Economics and Political Science*

MR R. HADLEY and MR A. L. WEBB

An evaluation of the contribution of young volunteers (organized by Task Force) to the provision of local social services for the elderly.

Approved support 1969–72: £13,210

University of London, St Mary's Hospital Medical School

DR G. A. ROSE

Community health study in the Paddington district.

See 65 for details

---

117. *University of London, University College, Environmental Design Research Unit*

PROFESSOR R. G. HOPKINSON

Measurement of noise and its effect on hospital staff and patients.

Approved support 1968–71: £17,554

---

118. *University of Manchester, Department of Social Administration*

PROFESSOR T. E. CHESTER

To test whether defects in the provision of services for old people are caused by organizational difficulties.

Approved support 1968–70: £5,750

University of Manchester, Hester Adrian Research Centre

DR P. MITTLER

The study of learning processes in the mentally handicapped.

See 23 for details

---

119. *University of Newcastle, Institute of Education*

PROFESSOR B. STANLEY

Development of language teaching methods for mentally retarded children.

Approved support 1967–71: £9,075

---

120. *Political and Economic Planning*

MRS B. SHENFIELD

The organization and role of volunteers for domestic visiting of the elderly.

Approved support 1969–71: £22,516

---

121. *University of Southampton, Department of Sociology and Social Administration*

MRS S. N. WANSBROUGH

Mental health; employment experiences of ex-psychiatric patients.

Approved support 1970–2: £3,000

---

122. *Southampton University, Wolfson Unit, Institute of Sound and Vibration Research*

DR A. C. MCKENNELL and MR C. G. RICE

Pilot study to assess the effect of sonic boom on working in Cornish hospitals.

Approved support 1970–1: £1,300

---

123. *University College of Swansea*

MR A. V. S. LOCKHEAD and MR B. GLASTONBURY

Homelessness in Wales and the South-west.

Approved support 1969–70: £4,000

Tavistock Institute of Human Relations

DR C. MURRAY PARKES

The psychological reactions to limb amputations.

See 90 for details

124. *Welsh National School of Medicine, Llandough Hospital, Penarth; The Maudsley Hospital*

PROFESSOR K. RAWNSLEY and DR K. M. LAURENCE; DR E. H. HARE

Family, social, emotional, and educational problems of 4–8-year-old children suffering from spina bifida cystica.

Approved support 1968–72: £15,000

---

125. *Westminster Hospital, Children's Prosthetic Unit, Queen Mary's Hospital*

MISS E. ROBERTSON

Follow-up study into the functional abilities at home and at school of multiple limb deficient children.

Approved support 1968–70: £7,947. *Continuing as a service*

---

126. *University of York, Department of Social Administration and Social Work*

PROFESSOR KATHLEEN JONES and MR D. T. CARTER

The social needs of the physically sick.

Approved support 1968–72: £27,240

OPERATIONAL AND MANAGEMENT RESEARCH PROGRAMMES

127. *University of Birmingham, Department of Engineering Production*

PROFESSOR K. B. HALEY

Operational research studies of medical care in general practice.

Approved support 1970–3: £11,000

---

128. *University of Essex, Department of Mathematics*

PROFESSOR G. A. BARNARD

Applications of operational research and computers in the NHS—including the cost of a computer terminal.

Approved support 1967–73: £140,000 (*provisional*)

---

129. *The General Nursing Council for England and Wales*

DR JILLIAN M. MACGUIRE

'GNC Research Unit.' Studies in the evaluation of training courses for nurses.

Approved support 1967–73: £82,000 (*provisional*)

130. MR D. HICKS, Chepstow, Mon.
Operational Research consultant to the DHSS.
Approved support 1967–72: £13,150

131. *Institute for Operational Research*
MR J. STRINGER
Operational research studies concerned with:
i. Development and evaluation of operational policies for hospitals, particularly the new district general hospitals which incorporate large ward units. Included under this head is the experimental use for resource planning of a computer terminal at Walsgrave Hospital.
ii. The development of techniques and methods for comprehensive planning of the health service for any given area.
Approved support 1967–72: £202,000

132. JOINT MEDICAL SERVICES COMMITTEE OF THAMESMEAD
Expenses of Advisory Committee Secretariat.
Approved support 1968–72: £4,000

133. *University of Lancaster, Department of Operational Research*
PROFESSOR M. G. SIMPSON and DR A. HINDLE
Operational research in the NHS. Various projects including:
i. Simulation models of activities within specialisms and between specialisms to assess resource allocation and admittance procedures.
ii. Evaluation of out-patient surgical facilities.
iii. A study of the provision of pathology services.
Approved support 1965–71: £44,000

134. *University of Leeds, Procter Department of Food and Leather Science*
PROFESSOR A. G. WARD and MR G. GLEW
Studies in catering technology.
Approved support 1966–76: £95,000. *Additional support by the Nuffield Provincial Hospitals Trust*
See also 1023

135. *University of Manchester, Manchester Business School*
PROFESSOR T. LUPTON
i. Study of management courses for ward sisters.
ii. Experiments in management at East Birmingham Hospital and management research at the United Manchester Hospitals.
Approved support: i. *1968–71:* £6,800; ii. *1967–70:* £12,920

136. *Operational Research Executive, National Coal Board*

MR R. C. TOMLINSON

Operational research in hospitals. Logistic problems.

Approved support 1968–71: £42,450

---

137. *University of Reading, Department of Applied Statistics*

PROFESSOR R. N. CURNOW

Operational Research (Health Services) Unit. To continue the work of the Unit initially sponsored and supported by the Nuffield Provincial Hospitals Trust.

Approved support 1970–3: £54,000

---

138. *Royal College of Nursing*

MRS U. INMAN

Development of measures of the quality of nursing care.

Approved support 1966–73: £110,000 (*provisional*)

OPERATIONAL AND MANAGEMENT RESEARCH PROJECTS

139. *University of Aberdeen, Department of Sociology, Centre for Social Studies*

PROFESSOR R. ILLSLEY

The registered nurse's view of general student nurse education.

Approved support 1969–70: £1,400

---

140. *Birmingham Regional Hospital Board*

Information retrieval project at Robert Jones and Agnes Hunt Hospital—orthopaedic records.

Approved support 1968–73: £25,500

University of Birmingham

PROFESSOR J. M. BISHOP

Information system for the safe and efficient handling of drugs in hospital.

See 37 for details

141. *University of Birmingham, and University of Aston in Birmingham, Graduate Centre for Management Studies.*

MR A. L. MINKES and DR DEREK WILLIAMS

Management and use of resources in hospitals: design and evaluation of training and development programmes.

Approved support 1970–4: £25,500

---

142. *East Anglian Regional Hospital Board*

Postgraduate training for GPs. For evaluation see 156.

Approved support 1969–73: £4,620

---

143. *University of Edinburgh, Department of Nursing Studies*

DRS M. SCOTT WRIGHT and M. GILMORE

Evaluation of experiment in use of a model nursing team with a group general medical practice. See 1016 for experiment.

Approved support 1968–73: £24,300

---

144. *University of Edinburgh, Department of Social Medicine*

DR J. M. LAST

Attitudes and ambitions of young doctors.

Approved support 1968–70: £2,500

Farnborough Hospital

DR PATRICIA G. WALLIS

A records system for ante- and perinatal events.

See 45

---

145. *Guy's Hospital Medical School, and the Hospital Centre*

DR R. W. REVANS

Hospital internal communications study. Action research project in ten hospitals in which the senior management tried to improve their efficiency through tripartite studies of their role, internal communications, and problems. Two books in press.

Approved support 1965–70: £62,560

---

146. *University of Hull, Department of Social Administration*

MR R. G. S. BROWN

Recruitment, wastage, and attitudes to training of male student and pupil nurses.

Approved support 1967–71: £12,700

147. *University of Keele, Computer Centre*

DRS H. H. GREENWOOD and R. A. JOHNSON

Data-processing in general practice—patient profiles.

Approved support 1970–1: £450

148. *University of Keele, Statistical Research Unit in Sociology*

MR R. E. A. MAPES

Statistical analysis and appreciation of mental health data.

Approved support 1969–71: £5,700

149. *Local Authorities Management Services and Computer Committee*

Development of standard local health authority computerized record systems.

Approved support 1969–73: £18,000 (*one-third of total cost*)

150. *University of London, Imperial College of Science and Technology, Industrial Sociology Unit*

PROFESSOR JOAN WOODWARD

Comparative evaluation of the management tasks in different hospitals.

Approved support 1970–3: £11,000 (*supported also by SSRC*)

151. *University of London, Imperial College of Science and Technology, Industrial Sociology Unit; St George's Hospital*

PROFESSOR JOAN WOODWARD; MRS RUTH POMERANZ

Comparison of an experimentally shortened course for SRNs with a standard three-year course.

Approved support 1966–71: £19,150

152. *University of London, London School of Economics and Political Science*

PROFESSOR B. ABEL SMITH and MRS H. ROSE

A study of the structure of demand and supply of pathology services.

Approved support 1967–70: £14,720

153. *University of London, London School of Economics and Political Science, Department of Social Administration*

DR BLEDDYN P. DAVIES

Measuring and explaining variations in local authority health and welfare service standards.

Approved support 1968–70: £9,700

154. DR I. S. L. LOUDON, J. K. HAWKEY, G. P. GREENHALGH, and G. T. BUNGAY
The Wantage Record Folder: a new records system, of size A4, for use in general practice.
Approved support 1969–71: £1.365

University of Manchester, Darbishire House Health Centre
DR P. S. BYRNE
Development and evaluation of vocational training programmes for GPs.
See 20

---

155. *University of Manchester, Department of Social Administration*
PROFESSOR T. E. CHESTER and DR J. H. BABSON
Costing of alternative treatment of particular diseases.
Approved support 1970–1: £6,300

---

156. *University of Newcastle, The Medical School*
PROFESSOR J. K. RUSSELL and DR J. H. WALKER
Evaluation of vocational training for GPs.
Approved support 1970–2: £5,200
See also 20 and 142

---

157. *Newport and Monmouthshire College of Technology, Department of Business Management Studies*
MR G. W. DAVIES
The evaluation of first-line management training for nurses in hospitals.
Approved support 1970–2: £3,000

---

158. *North-east Metropolitan Regional Hospital Board (Operational Research team)*
i. Effective use of geriatric beds and associated facilities in the Harlow Group.
ii. Performance and benefit of the Intensive Therapy Unit at Whipps Cross Hospital.
Approved support 1968–71: £22,150

---

159. *Oxford Regional Hospital Board*
DR A. BARR
Comparative study of patient care; studies of nurse staffing in the Oxford region.
Approved support 1968–71: £9,000

160. *Political and economic planning*
The scope and role of the private sector of medical practice.
Approved support 1970: £2,500, *preliminary study*

United Birmingham Hospitals, Queen Elizabeth Hospital
DR J. L. WHITBY
Computer data-processing techniques—application to hospital bacteriological laboratory.
See 79

---

161. *Queen's Institute for District Nursing*
MISS L. HOCKEY
Recruitment, training, employment, and work of state-enrolled nurses in local authority nursing services.
Approved support 1970–2: £23,000

---

162. *The Royal Medico-Psychological Association*
DR C. P. B. BROOK
Psychiatric hospitals and units—criteria for accreditation. Postgraduate education and training of psychiatrists. Career patterns, intentions, and expectations of trainees with particular reference to overseas graduates.
Approved support 1970–1: £11,000

---

163. *St Mary's Hospital*
Local Government Operational Research Unit, RIPA
Study of nursing staff structure at St Mary's Hospital.
Approved support 1970–1: £2,000

St Thomas's Hospital
PROFESSOR P. RHODES and DR JOANNA SOUTH
Automatic data-processing of obstetric records by computer techniques.
See 88 for details

---

164. *Sheffield Regional Hospital Board; University of Nottingham (Department of Applied Social Science)*
MR W. M. NAYLOR
Management problems of integrated health services:
i. Local organization of a unified health service.
ii. Management of resources within a health care organization. Cost of secondment during studies.
Approved support 1970–1: £6,250

165. *Sheffield Regional Hospital Board*

Collection and processing of data on the demand for psychiatric services in the area of Mapperley Hospital, Nottingham.

Approved support 1963–71: £6,219

---

166. *South-east Metropolitan Regional Hospital Board and University of Kent*

PROFESSOR D. J. BARTHOLOMEW

Study of the manpower planning requirement of the South-east Metropolitan RHB.

Approved support 1972–3: £2,300

---

167. *University of Southampton, Department of Sociology and Social Administration*

PROFESSOR J. H. SMITH

Manpower analysis for hospitals—a study of employment of ancillary hospital staff in Wessex region and of their previous employment and background. Development of basic manpower record.

Approved support 1966–70: £15,232 (+ £4,800 *from Wessex RHB*)

---

168. *University College of South Wales and Monmouthshire, Department of Sociology*

PROFESSOR P. HALMOS

Studies in the sociology of nursing and nursing education.

Approved support 1969–72: £15,513

---

169. *Welsh National School of Medicine, General Practice Unit*

DR R. HARVARD DAVIS

Evaluation of an integrated records system for doctors and nurses working in a health centre, together with the devising and testing of systems to facilitate computerization of these records and automatic production of screening schedules.

Approved support 1969–72: £2,115

---

170. *Wessex Regional Hospital Board*

Study of problems associated with the management of large nursing units —with Institute for Operational Research—see 131.

Approved support 1970–4: £29,550

2. Service developments

Developments, for the purposes of this section of the programme, are of two types, namely:

A. Experiments set up to test, assess, and demonstrate new methods, or forms or patterns of service.

In all cases provision is made for the evaluation of the results either within the project itself, or by independent research.

Where an independent evaluation can be identified in the list as a separate project, a reference is given in the development entry. A good deal of other evaluation work is carried out for the Department by the research 'units', and programme teams.

B. Special support to facilitate the rational assimilation of a new service—for example the rapid introduction of a new life-saving treatment, such as haemodialysis for chronic kidney disease; or measures to meet a social emergency, such as the establishment of treatment and research centres for drug addiction; or, in collaboration with the MRC, combined treatment and research centres in important medical areas, such as leukaemia; or for the introduction of new services, following applied research which need to be specially distributed and phased with regard to the available skills and other resources, such as renal transplantation centres.

Revenue finance for the developments of type B is usually provided on a recurring basis.

A. EXPERIMENTS IN METHODS AND FORMS OF SERVICE

1001–9. *Department of Health and Social Security, Laboratory Automation Trials Group*

A programme of studies initiated by the LATG to study the effect on the efficiency of pathological services and on the quality of patient care to be derived from the computerization, increased automation, and reorganization of methods in the laboratories.

1001. *Hammersmith and St Mark's Hospitals, London W*
PROFESSOR I. D. P. WOOTTON
1967–71: £62,970 *capital,* £46,000 *revenue*

1002. *Poole General Hospital, Wessex Regional Hospital Board*
DR. A. G. RICKARDS and J. H. JOHNSTONE
1969–71: £5,910 *capital,* £13,500 *revenue*

1003. *Queen Elizabeth Hospital, Birmingham, United Birmingham Hospitals, and University of Birmingham*
PROFESSOR T. P. WHITEHEAD
1967–70: £77,000 *revenue (from 1 April 1971 included in Wolfson Laboratories—see* 1)

1004. *St Stephen's Hospital, Chelsea, South-west Metropolitan Regional Hospital Board*
DR M. G. RINSLER
1968–71: £40,130 *capital,* £20,850 *revenue*

1005. *South Warwickshire Hospital Management Committee, Birmingham Regional Hospital Board*
DR M. K. ALEXANDER
1969–71: £42,880 *capital,* £21,280 *revenue*

1006. *United Sheffield Hospitals and Sheffield Regional Hospital Board*
DR A. JORDAN
1969–71: £40,235 *capital,* £17,865 *revenue*

1007. *University College Hospital, London*
PROFESSOR F. V. FLYNN
1967–71: £48,800 *capital,* £79,000 *revenue*

OTHER RELATED STUDIES

1008. *King's College Hospital Medical School and King's College Hospital*
PROFESSOR C. H. GRAY
The development of a Digico Micro 16 computer system for general data-processing, transmission, and recording in a hospital biochemical laboratory.
1969–72: £25,525 *capital,* £8,880 *revenue*

1009. *Dudley Road Hospital, Birmingham*
DR M. J. CHAMBERLAIN and MR W. B. YEOMAN
Project to assess the impact of out-patient biochemical screening on the work-load and clinical practice of a large general hospital. Biochemical profile of an unselected out-patient population.
1970–1: £9,670 *capital,* £13,360 *revenue*

1010–15. *Department of Health and Social Security; Departmental Working Party on Intensive Coronary Care*
A programme of trials in treatment methods for acute myocardial infarction. Trials still current in 1971:

1010. *Royal Devon and Exeter Hospital, Exeter*
DR D. B. SHAW
1967–71: £28,500 *revenue*

1011. *Scott Hospital, Plymouth*
DR G. R. STEED
1967–71: £23,000 *revenue*

1012. *Southmead Hospital, Bristol*
DR H. G. MATHER and DR H. J. WRIGHT
1967–71: £25,600 *revenue*

1013. *Torbay Hospital, Torquay*
DR M. G. THORNE
1968–71: £14,000 *revenue*

The above trials to compare the treatment of patients in an intensive therapy unit with similar patients treated at home.

1014. *The General Hospital, Birmingham*
DR B. L. PENTECOST
Assessment of the efficacy of a mobile coronary care unit in the treatment of acute myocardial infarction.
1968–70: £13,000 *revenue*

1015. *Hammersmith and St Mark's Hospitals, London W and the Greater London Council*
Trial coronary care ambulance service.
1970–1
See 47 for evaluation

1016–19. Current trials in organization of general practice

1016. *The Council for the Training of the Health Visitor, London*
Investigation of a model nursing team working with a group general medical practice.
1968–73: £8,000 *revenue*
See 143 for evaluation

1017.
DRS C. B. FLOYD and G. GOMEZ
General practices in Surrey.
DRS E. T. GRIFFITHS and M. WADE
General practices in Monmouthshire.
A scheme for the transport of patients to surgery in general medical practice.
1967–70: £23,000 *revenue*
See 96 for evaluation

1018. LIVERPOOL PERSONAL SERVICE SOCIETY INC. and DRS L. RATOFF, G. N. YATES, and MURIEL G. YATES

The effects of the attachment of a social worker to a general medical practice.

1969–72: £23,650 *revenue*

See 22 for evaluation

1019. *University of Southampton, Faculty of Medicine*

DR J. A. FORBES

Redistribution of work-load following attachment of a nurse to a general medical practice.

1967–70: £2,980 *revenue*

1020. *Bedford Group Hospital Management Committee*

DR J. D. HARTE

Occupational health service for hospital staff at Bedford General Hospital.

1968–73: £25,500 *revenue*

1021. *Hollymoor Hospital Adolescent Unit, Birmingham*

PROFESSOR W. H. TRETHOWAN and DR EDNA IRWIN

Evaluation of the work of an experimental unit for the treatment of disturbed adolescents as in-patients—five years' trial.

1968, 1971–6: £28,040 *capital,* £25,000 *revenue*

1022. MANCHESTER REGIONAL HOSPITAL BOARD

Additional expenditure involved in extra laboratory and computing facilities arising from research need for repeated rescreening of the population at intervals more frequent than in normal service arrangements in connection with the Manchester Cervical Screening Project.

1966–71: £98,500 *revenue*

See also 22

1023. NEWCASTLE REGIONAL HOSPITAL BOARD and PROCTER DEPARTMENT OF FOOD AND LEATHER SCIENCE, UNIVERSITY OF LEEDS

Development and assessment of an area hospital catering system based on centrally prepared and frozen food.

1970–2: capital and revenue costs being assessed

See also 134

1024. *City of Portsmouth*

DR I. G. CHRISTIE

Alpha experimental hostel for rehabilitation of withdrawn drug addicts. Programme for evaluation being prepared by the Institute of Psychiatry.

1970–4: revenue costs being assessed

1025. *St Thomas's Hospital Medical School and St Thomas's Hospital, London SE*

PROFESSOR W. W. HOLLAND

Study of support in the community of persons dependent on mechanical respiration following poliomyelitis.

1970–2: revenue costs being assessed

1026–7. Trials in integrated area services organized by the Department of Health and Social Security and service authorities:

1026. *Worcester City and County Councils and Mid-Worcester Hospital Management Committee*

Development, evaluation, and demonstration of a modern community-based service for the mentally ill.

1027. *Sheffield City Council and Sheffield Regional Hospital Board*

Development, evaluation, and demonstration of a modern, community-based service for the mentally handicapped.

Costs being assessed

B. SPECIAL DEVELOPMENTS

1028. *Borocourt Hospital, Oxford Regional Hospital Board*

Special unit for blind subnormal children.

Capital £128,000, *revenue* £26,000 *p.a. from 1971*

1029. *Fulham Hospital, Charing Cross Hospital*

DR K. D. BAGSHAWE

i. Unit for research and treatment of leukaemia (children) (jointly with MRC).

ii. Unit for research and treatment of trophoblastic tumours in men and women. Research in circulating tumour associated antigens.

i. *Capital* £38,000, *revenue* £30,330 *p.a. from 1970*

ii. *Revenue* £17,200 *p.a. from 1969*

1030. *Guy's Hospital, London*
Development of a Poisons Reference Service at New Cross Hospital.
Capital £110,000, *revenue* £62,500 *p.a. from* 1971

1031. *Guy's Hospital, and National Heart Hospital, London*
DR G. E. SOWTON
i. The development of techniques for the detection of impending cardiac pacemaker failure; development of a cardiac pacemaker service at the hospitals.
Revenue £5,000 *and* £15,000 *p.a. respectively for the two hospitals from 1970*
ii. Comparative study of different models of pacemaker—on equipment programme.

1032. *Guy's Hospital, London*
PROFESSOR SIR HEDLEY ATKINS and MR J. L. HAYWARD
Development of a unit concerned with research into the treatment of early breast cancer by means other than radical mastectomy; and of late breast cancer by endocrine ablative procedures and by cytoxic drugs.
Capital £99,850, *revenue* £41,000 *p.a. from* 1970

1033. *University Hospital of South Manchester, Department of Haematology (Withington Hospital)*
DR L. POLLER
The production of the British comparative thromboplastin reference reagent used as the basis for the British system for anticoagulant control of prothromblin time estimations.
Capital £2,460, *revenue* £6,300 *p.a. from 1971*

1034. *National Blood Transfusion Service*
i. *North London Blood Transfusion Centre*
DR T. E. CLEGHORN
a. Preparation of human anti-tetanus immunoglobulin. *b.* Panel of accredited donors for fibrinogen.
Revenue a, £3,800; *b,* £5,800 *p.a. from 1970.* See also 71
ii. *National Blood Transfusion Centre, Manchester*
DR F. STRATTON
Panel of accredited donors for fibrinogen.
Revenue £3,250 *p.a. from 1971.*
iii. *Birmingham Blood Transfusion Centre—Hypogammaglobulinaemia service*
Revenue £7,350 *p.a. from 1970.* See also 72

1035. *University of Newcastle and Newcastle Regional Hospital Board*

PROFESSOR S. D. M. COURT

Development and assessment of a child assessment centre purposing to bring together the main professional disciplines concerned with the assessment and care of children with complex and multiple handicaps, to develop and assess the functions of a regional and a district assessment centre, to assist in the development of 'district services' and to study the patterns of care needed by and acceptable to handicapped children and their families.

Capital £20,250 (*support also from the Nuffield Provincial Hospitals Trust and the Northern Association of Education Committee*)

1036. *Royal Postgraduate Medical School and Hammersmith and St Mark's Hospitals, London*

DR G. A. G. GALTON and PROFESSOR J. V. DACIE

Unit for research and treatment of leukaemia (jointly with MRC).

Capital £162,000, *revenue* £56,000 *from 1972*

1037. *University of London, Institute of Child Health and the Hospital for Sick Children*

DR K. S. HOLT

Support for the development of the Wolfson Assessment Centre (for children).

Revenue £10,000 *p.a. from 1970*

1038. *Guy's Hospital, London*

DR R. C. MCKEITH

Expansion of the Newcomen Centre for child assessment—providing service, teaching, and research facilities.

Capital £70,000 (*est.*) *for first stages; revenue costs to be assessed*

1039. *University of London, Institute of Ophthalmology, and Moorfields Eye Hospital*

PROFESSOR BARRIE R. JONES

Development of laboratory diagnostic methods for chlamydial infections of the eye or genital tract (trachoma, inclusion conjunctivitis, lymphogranuloma venereum, and related infections). Expansion of these services for Moorfields, the London, and St Bartholomew's Hospitals. This work is a development of the results of research by former MRC Oculo-genital Research Group.

Revenue £7,400 *for equipment and* £9,000 *p.a. from 1970*

1040. *University of Newcastle, Department of Psychological Medicine, and Newcastle Regional Hospital Board*

PROFESSOR M. ROTH

Establishment of an experimental observation and assessment unit for psycho-geriatric patients. Associated research:

i. Evaluation of results of early comprehensive assessment and treatment.

ii. Development of approved quantitative measures of the cognitive deficiencies of elderly subjects.

Capital £82,000, *revenue support* £10,500–12,000 *p.a. 1969–71*
See also 26

1041. *University of Oxford, Unit of Clinical Epidemiology, and Oxford Regional Hospital Board*

DR J. A. BALDWIN

Oxford Record Linkage Study—Development of a linked medical records system for the Oxford Region. See also 30.

Second Phase covering whole region, revenue £25,000 *p.a., excluding costs of temporary computing facilities.*

1042. *The Hospital for Sick Children*

Development of a unit for infant cardiac surgery to provide a wide service.

Support for capital cost £500,000, *running costs to be assessed*

1043. *Various centres*

Development with the advice of a Renal Transplantation Advisory Committee of centres for renal transplantation—special support for capital and running costs.

Capital expenditure up to 31 March 1971 £125,000*; consequent revenue* £105,000 *p.a. from 1971*

---

3. Equipment, supplies, and appliances

The Department's activities in this field include:

a. Arrangements with other Government scientific research establishments for research in support of the development of equipment and supplies. The establishments chiefly concerned at the present time are the Atomic Weapons Research Establishment, Aldermaston; the Atomic Energy Research Establishment, Harwell; the Microbiological Research Establishment, Porton; and the Services Electronics Research Laboratory, Baldock.

b. There are collaborative projects with a number of university

departments and hospital authorities covering research on a wide range of topics. The Wolfson Research Laboratory at Birmingham, where research is undertaken into problems of pathology laboratory automation, is a case in point. Certain projects have been undertaken jointly with the MRC. There is close liaison with the National Research Development Corporation.

c. The Department has its own experimental establishment, the Biomechanical Research and Development Unit, Roehampton, which deals with artificial limbs of advanced types.

d. In addition a great deal of effort is devoted, in collaboration with the users, to the critical evaluation of a wide range of items of equipment and appliances.

The support given usually takes the form of a grant (which in some cases may amount in effect to the lending of equipment required for particular experiments); but the grants are always made in connection with specified projects.

In the list which follows an attempt has been made to divide the projects shown into 'research' and 'development' but the distinction is one that is often extremely difficult to draw in practice. Many projects contain elements of both.

The activities are listed as follows:

Those carried on by government establishments—E1–E11.

Those in collaboration with university departments—E12–E21.

Those in collaboration with NHS hospitals—E22–E42.

Government establishments

RESEARCH

E1. *Atomic Weapons Research Establishment, Aldermaston*

There is a programme of research, financed by the DHSS on the following topics:

Corrosion studies and metallurgical and mechanical investigations of surgical implants.

A recirculating system for intermittent haemodialysis, in which the dialysing fluid is purified for reuse instead of being run to waste.

The identification of metabolites in the blood of uraemic patients, and related studies; advanced techniques of isolation and identification are employed.

Studies in conjunction with the Eastman Dental Hospital on the degradation of dental fillings *in situ*; and on the cutting action of dental burrs. Continuing programme.

1970–71: £79,000

Design and construction of laser equipment for use at the Royal College of Surgeons in the experimental study of the application of the laser to surgery.

Development of methods and automated equipment for the extraction of drugs from body fluids in cases of suspected addiction, for use at the Poisons Reference Centre.

Design and construction of experimental equipment for investigating the application of holographic techniques to diagnostic procedures (radiology, ultrasonics).

Design of an advanced type of gamma camera.

Design of pessaries for treating incontinence.

Design and construction of an experimental hip joint movement simulator for investigations in connection with research on artificial hip joints (in conjunction with the Institute of Orthopaedics, Stanmore).

Reinforcement of denture base materials; radio-opaque denture materials; improved anterior dental fillings.

E2. *Department of Health and Social Security*

Plastics in medicine. Dr K. Little working under contract from the DHSS and using facilities at UKAEA laboratories has just completed a three-year programme of investigations into the biological compatibility of plastics. This has included a study of the surface finish of implants and devising methods for testing plastics in terms of biological hazards.

1968–71: £18,000

E3. *Microbiological Research Establishment, Porton*

L-asparaginase. Production of experimental quantities of L-asparaginase for clinical work on the treatment of leukaemia.

1968 (continuing): £440,000

DEVELOPMENTS

E4. *Atomic Weapons Research Establishment, Aldermaston*

A number of exploratory developments is in hand, including the following:

A drill for the clearance of obstructed arteries.

Method of assessing the level of performance of image intensifiers.

Collaborative work on the laboratory assessment of the toxicity of plastics.

Design of cardiac pacemakers; encapsulation processes; voltage converter for use with isotope-powered batteries.

Development of high-speed high-performance infra-red scanning equipment.

E5. *Department of Health and Social Security (Scientific and Technical Branch) and Industry*

Blood pressure transducer. The aim is to develop a miniature intravascular blood pressure sensor which can be mounted on the tip of a catheter for measurements in the arterial system and later, possibly, also in the venous system.

1971–2: £7,000

E6. *Department of Health and Social Security (Scientific and Technical Branch) and Industry*

Invalid road transport. A three-wheeled road vehicle of much improved design has been developed. It has fully automatic transmission and a quieter, more powerful engine. Extensive user trials of pre-production models have been made and production will begin in April 1971.

1967–71: £30,000

E7. *Department of Health and Social Security; Services Electronics Research Laboratory; and Elliott Automation*

Neutron radiation therapy. A joint programme has led to the development of equipment for neutron therapy of tumours. The first installation will be in May 1971 at the Christie Hospital, Manchester, and the second in September 1971 at the Belvedere Hospital, Glasgow.

1968–71: c. £600,000

E8. *Department of Health and Social Security (Scientific and Technical Branch) and Industry*

Pedestrian-controlled wheelchair. A battery-powered wheelchair has been developed for situations where the patient is incapable of controlling it and the attendant is unable to push an unpowered model. Good results were obtained from user trials and the wheelchair is being manufactured as a standard item.

1968–70: £3,500

E9. *Department of Health and Social Security (Scientific and Technical Branch) and Industry*

Wheelchairs. New types of folding lightweight wheelchairs have been developed and similar work is in progress with other ranges of wheelchairs. An in-depth survey of wheelchair users' requirements is to be carried out.

1969–74: £30,000

E10. *United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Harwell*

Semi-Conductor Radiation Detection Probes. Used for gamma and beta measurements *in-vivo*. Two forms of probe have been developed:

a. Planar detectors for use in superficial tissue.

b. Cylindrical detectors for use in body cavities, for example, during radium treatment of cervical cancer. Associated equipment such as amplifiers has also been developed.

1969–71: £18,000

E11. *United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Harwell*

Super-fine focus X-ray tube. Development of a tube in which the X-ray beam comes from a micro-sized target. This allows the image of a particular part of the anatomy to be greatly enlarged without loss of definition. The tube will be linked to an image intensifier and evaluated primarily for orthopaedic work at Oswestry Orthopaedic Hospital.

1969–71: £12,000

Universities and royal colleges

RESEARCH

E12. *Royal College of Surgeons*

MR R. R. HALL

Lasers in surgery. A gas laser has been provided for investigations into its suitability for surgery.

1968–71: £3,000

E13. *University of Birmingham, Wolfson Research Laboratories, Birmingham*

Automation of laboratory processes. This is a joint undertaking by the DHSS, the United Birmingham Hospitals, and Birmingham University, together with support from the Wolfson Foundation. The programme is directed mainly toward the automation of procedures in biochemistry laboratories.

1971/continuing: £90,000

E14. *University of Exeter, Department of Chemical Engineering*

PROFESSOR M. LACEY

Haemodialysis. A study of the flow of liquids in haemodialysis equipment with the purpose of (*a*) eliminating design features which cause difficulty

with sterilization and/or mixing of water/dialysate concentrate and (*b*) determining optimum sites for various measuring electrodes.
1970–3: £11,300

E15. *University of London, Imperial College of Science and Technology, Department of Mechanical Engineering*
PROFESSOR S. A. V. SWANSON and DR M. A. R. FREEMAN
Research on the mechanism of failure in compact bone, the mechanical properties of articular cartilage and soft tissue load transmission through the spine, and lubrication and wear in synovial joints.
1969–72: £44,000

E16. *University of London, Queen Mary College, Department of Mechani cal Engineering*
PROFESSOR M. W. THRING
Research aimed at the development of a battery-operated child's carriage, with a step-climbing capability, for use by those severely disabled.
1967–70: £8,000

E17. *Strathclyde University, Radiation Laboratory*
DR A. WARD
Research on recognition strategy in relation to automated differential white blood cell counting.
1970: £1,000

DEVELOPMENTS

E18. *University of Surrey Wolfson Bioanalytical Centre*
DR E. REID
Thin-layer chromatography. Development of an automated system.
1969–72: £10,000

E19. *Essex University, Department of Electrical Engineering Science; University College Hospital, Medical Physics Department*
PROFESSOR G. G. B. CHAPLIN and MR J. S. CLIFTON
Development of a simplified data manipulation, display, storage, and retrieval system specially designed for use with patient monitoring and related systems though with potential applications in other fields.
1969–72: £20,000

E20. *University of London, Guy's Hospital Medical School*

MR D. R. SCRUTTON

Surgical appliances. Improved lower limb bracing for children.

1970–3: £9,300

E21. *Salford University*

MR J. T. HENSHAW

Surgical appliances. Development of lower limb bracing with improved cosmesis.

1969–74: £2,500

Hospitals and others

RESEARCH

E22. *Addenbrookes Hospital, Cambridge*

PROFESSOR R. CALNE

Charing Cross Hospital, London

MR G. WILLIAMS

Hammersmith Hospital, London

PROFESSOR R. SHACKMAN

Determination of optimum conditions/equipment for storing donor organs for transplant.

1968–72: £28,000

E23. *Hammersmith Hospital, London, and University of London Royal Postgraduate Medical School*

DR S. M. LEWIS

Anti-coagulants for blood specimen containers. Each year about 20 million vials containing a small amount of anti-coagulant are used. The research is to determine the optimum quantity and the correct anti-coagulant for the various laboratory tests.

1969–72: £4,000

E24. *Queen Victoria Hospital, East Grinstead*

MR M. J. HACKETT

Thermography. An investigation of the value of thermography and the development of appropriate techniques for assessing the full depth area of burns. Excellent results are being achieved which are affording decisions about the timing of plastic surgery to be made much sooner than with

conventional methods of judgement. Similarly promising findings are being obtained when thermography is used to assess blood supply conditions to tubular grafts.
1970–1: £8,000

E25. *Royal National Orthopaedic Hospital, London*
DR J. T. SCALES
Hip-joint prosthesis. Research into the wear and corrosion characteristics of various types of hip-joint prosthesis.
1969–72: £35,000

E26. *Royal Victoria Infirmary Newcastle*
PROFESSOR D. N. S. KERR
Haemodialysis. Laboratory and clinical assessment of dialysers with the aim of improving the performance of future equipment.
1969–73: £8,500

E27. *St Bartholomew's Hospital, London*
DR B. WATSON
Auditory evoked response. Support, including provision of a small averaging computer, for a programme of investigation into a method of testing hearing via a change in the EEG when the subject is exposed to a sudden loud noise. The hope is to ultimately develop a screening test for babies who appear not to respond to audiometry for reasons other than deafness, e.g. autism.
1969–72: £5,000

E28. *St Martin's Hospital, Bath*
MR K. LLOYD WILLIAMS and DR B. PHILIPS
Thermography. Two current aspects of an extensive programme are the application of thermography to (*a*) diagnose and localize incompetent perforating leg veins, and (*b*) diagnose carotid stenosis by examining temperature patterns in the supra-orbital areas.
1969–73: £23,000

E29. *Several hospitals and investigators*
Incontinence control. Urinary incontinence can be sometimes controlled by the application of electrical stimuli. Trials are being undertaken to examine the practicability and effectiveness of a method in which the electrical pulses are applied via small contacts mounted on a pessary.
1970–1: £1,200

DEVELOPMENTS

E30. *Bristol Royal Infirmary, Department of Medical Physics*

DRS F. G. M. ROSS and H. F. FREUNDLICH

Development of a high-performance ultrasonics scanner and the investigation of the application of ultrasonics to various diagnostic procedures including the study of the liver and heart movements. The investigation of associated problems such as data presentation and transducer design.

1967–71: £12,000

E31. *Cardiff Maternity Hospital*

PROFESSOR A. C. TURNBULL

Infusion of oxytocin in labour. A new infusion pump has been developed and is available commercially. Further work has led to a fully automated system in which the rate of oxytocin infusion is regulated by the strength and frequency of uterine contractions.

1969–71: £4,000

E32. *Middlesex Hospital, London*

DRS K. E. BRITTON and N. J. BROWN

Nuclear Enterprises Ltd

Renography equipment. This development has resulted in a mobile couch incorporating all the apparatus of a three-channel renography system with blood background substraction facility. It does not need the services of a physicist for operation. Production models are to be provided for evaluation.

1968–71: £42,000

E33. *Orpington Hospital, Kent*

DR K. J. RANDALL

Cambridge University, Department of Pathology

DR J. H. TUCKER

Automation of cervical screening. Development of techniques for automatically preparing cervical specimens in a form suitable for presentation to the equipment mentioned in project no. 37.

1970–2: £6,000

E34. *Royal National Orthopaedic Hospital, London*

DR J. T. SCALES

Hip-joint prosthesis. Development and long-term clinical assessment of a total hip-joint replacement prosthesis.

1968 (continuing)

E35. *Royal Salop Infirmary, Shrewsbury*
MR G. K. ROSE
Surgical appliances. Development of improved splinting for spina bifida.
1969–72: £9,500

E36. *Shoe and Allied Trades Research Association*
Development of footwear for the arthritic foot.
1969 (continuing): £2,500 *(to date)*

E37. *St Mary Abbots Hospital, London*
DR O. A. N. HUSAIN
Automation of cervical screening. A prototype equipment is being evaluated as a possible means of automatically scanning and classifying cervical smears as 'clear' or 'suspicious'. In the latter case, the particular specimen is investigated by a cytologist.
1969–72: £23,000

E38. *St Mary's Hospital, London*
PROFESSOR R. E. O. WILLIAMS
The mechanization of laboratory microbiological procedures.
1968–71: £15,000

E39. *The London Hospital, London*
DR D. F. SCOTT
Cerebral function monitor. Development of techniques and instrumentation for continuous monitoring of the brain's electrical activity in the case of comatose patients and the provision of a clear indication of vital changes in cerebral activity.
1969–71: £3,000

E40. *University College Hospital, London*
MR J. S. CLIFTON
Essex University, Department of Electrical Engineering Science
PROFESSOR G. B. B. CHAPLIN
Blood gas analysis/mass spectrometry. Work at Essex University is aimed at development of an easily operated mass spectrometer for use in a clinical environment to provide on-line analysis of blood gases. The development of suitable catheter probes for use with this system is being undertaken at University College Hospital.
1970–3: £21,000

E41. *Walton Hospital, Liverpool*

DR S. LIPTON

Percutaneous cordotomy. Development of techniques and devices for selective destruction of nerve fibres involving extremely precise, micro-manipulation of the electrodes from a lesion generator. The method is used to relieve intractable pain in terminal cases.

1969–71: £3,500

E42. *Westminster Hospital, London*

MR C. DREW

Blood pump. Support for development of pulsatile flow blood pump for long-term pumping.

1969 (continuing): £4,500

Publications

1. Medical, social, and operational research

RESEARCH UNITS

1

WHITEHEAD, P.P. (1968). 'The use of laboratory screening procedures in clinical biochemistry', *Biomed. Engng*, **13**, 467–72.

—— BECKER, J.F., and PETERS, M. (1968). 'Data processing in a clinical biochemistry laboratory', in McLachlan, G. and Shegog, R.A. (eds), *Computers in the Service of Medicine*, vol. i (Oxford University Press for the Nuffield Provincial Hospitals Trust).

—— and CARMELT, M.H.B. (1969). 'Laboratory screening procedures in a clinical biochemistry laboratory', *Br. J. of Hosp. Med.* **2**, 4, 49–51.

—— —— (1969). 'The use of laboratory screening procedures in clinical biochemistry', *Midland med. Rev.* **6**, 1, 11–21.

—— (1969). 'The computer in the laboratory', *The Practitioner*, **203**, no. 1215, 294–304.

CARMELT, M.H.B., FREEMAN, P., STEPHENS, A.J.H., and WHITEHEAD, P.P. (1970). 'The value of routine multiple blood tests in patients attending the general practitioner', *Br. med. J.* **1**, 620–3.

2

RAYNES, N.V., and KING, R.D. (1968). 'An operational measure of inmate management in residential institutions', *Soc. Sci. and Med.* **2**, 41–53.

—— —— (1968). 'Patterns of institutional care for the severely subnormal', *Am. J. ment. Defic.* **72**, no. 5, 700–9.

HOSPITAL ORGANIZATION RESEARCH UNIT (1969). *Ward Housekeeping*. Occasional paper. (1) 'Sapiential authority and secondment: the organization of housekeeping staff in the ward'. (2) 'The ward housekeeper: a proposal based on organizational analysis', *Nursing Times* (4 December).

—— (1969). 'Engineering and building services in the hospital—an organizational analysis', *Hosp. Bldg and Engng*, pt 1 (March); pt 2 (September).

ROWBOTTOM, R.W. (1970). 'Basic themes for organization', *Br. Hosp. J.* (January).
—— and HEY, A.M. (1970). 'Towards an organization of Social Service Departments', *Local Govt Chron.* (September).
KOGAN, M. (1970). 'Hospital management and administration' (*N.H.S.—three views, Fabian Research Series*, no. 287).

3

In connection with the Exeter Community Health Research Project.

ASHFORD, J.R., and PEARSON, N.G. (1970). 'Who uses the health service and why?', *Jl R. statist. Soc.*, ser. A., **133**, 3, 295.

On studies of perinatal mortality and morbidity in South-west England and England and Wales generally.

BRIMBLECOMBE, F.S.W., ASHFORD, J.R., and FRYER, J.G. (1968). 'The significance of low birth weight in perinatal mortality. A study of variations within England and Wales', *Br. J. prev. soc. Med.* **22**, 27–37.
ASHFORD, J.R., BRIMBLECOMBE, F.S.W., and FRYER, J.G. (1969). 'Birthweight and perinatal mortality in England and Wales 1956–1965', in *Problems and Progress in Medical Care*, Third Series, McLachlan, G. (ed.) (Oxford University Press for the Nuffield Provincial Hospitals Trust).
—— FRYER, J.G., and BRIMBLECOMBE, F.S.W. (1969). 'Secular trends in late foetal deaths, neonatal mortality and birth weight in England and Wales 1956–65', *Br. J. prev. soc. Med.* **23**, 154–62.

On field surveys and statistical studies of respiratory systems and ventilatory function in large populations.

ASHFORD, J.R., BROWN, S., MORGAN, D.C., and RAE, S. (1968). 'The pulmonary ventilation function of coal miners in the U.K.', *Am. Rev. Resp. Dis.* **97**, 5, 810.
—— MORGAN, D.C., RAE, S., and SOWDEN, R.R. (1970). 'Respiratory symptoms in British coal miners', ibid. **102**, 370.
—— and SOWDEN, R.R. (1970). 'Multivariate probit analysis', *Biometrics*, **26**, 3.

4

EDWARDS, G. (1966). 'Hypnosis in the treatment of alcohol addiction', *Q. Jl Stud. Alc.* **15**, 147–9.
—— HAWKER, A., WILLIAMSON, V., and HENSMAN, C. (1966). 'London's Skid Row', *Lancet*, **i**, 775–9.
—— and GUTHRIE, S. (1966). 'A comparison of in-patient and out-patient treatment of alcohol dependence', ibid. **i**, 467–8.
—— HENSMAN, C., HAWKER, A., and WILLIAMSON, V. (1966). 'Who goes to Alcoholics Anonymous?', ibid. **ii**, 382–4.
—— HAWKER, A., and HENSMAN, C. (1966). 'Setting up a therapeutic community', ibid. **ii**, 1407–8.
—— (1966). 'The relevance of the American experience of narcotic addiction to the British scene', *Br. med. J.* **3**, 425–9.
—— and GUTHRIE, S. (1967). 'A controlled trial of in-patient and out-patient treatment of alcohol dependence', *Lancet*, **i**, 555–9.
—— HENSMAN, C., HAWKER, A., and WILLIAMSON, V. (1967). 'Alcoholics Anonymous: the anatomy of a self-help group', *Soc. Psychiat.* **1**, 195–204.
—— KELLOG-FISHER, M., HAWKER, A., and HENSMAN, C. (1967). 'Clients of alcoholism information centres', *Br. med. J.* **4**, 346–9.

EDWARDS, G. (1967). 'The meaning and treatment of alcohol dependence', *Hosp. Med.* **2**, 272–81.

HAWKER, A., EDWARDS, G., and HENSMAN, C. (1967). 'Problem drinkers on the payroll', *Med. Offr*, **118**, 313–15.

EDWARDS, G. (1968). 'The problems of cannabis dependence', *The Practitioner*, **200**, 226–33.

—— (1968). 'Patients with drinking problems', *Br. med. J.* **4**, 435–7.

—— WILLIAMSON, V., HAWKER, A., HENSMAN, C., and POSTOYAN, S. (1968). 'Census of a reception centre', *Br. J. psychiat.* **114**, 1031–9.

GATH, D., HENSMAN, C., HAWKER, A., KELLY, M., and EDWARDS, G. (1968). 'The drunk in court: a survey of drunkenness offenders from two London courts', *Br. med. J.* **4**, 808–11.

GELDER, M.G., and EDWARDS, G. (1968). 'Metronidazole in the treatment of alcohol addiction: a controlled trial', *Br. J. psychiat.* **114**, 437–75.

HENSMAN, C., CHANDLER, J., EDWARDS, G., HAWKER, A., and WILLIAMSON, V. (1968). 'Identifying abnormal drinkers: prevalence estimates by general practitioners and clergymen', *Med. Offr*, **120**, 215–20.

KOSVINER, A., MITCHESON, M., MYERS, K., OGBORNE, A., STIMSON, G., ZACUNE, J., and EDWARDS, G. (1968). 'Heroin use in a provincial town', *Lancet*, **i**, 1189–92.

EDWARDS, G. (1969). 'The British approach to the treatment of heroin addiction', ibid. **i**, 768–72.

HAWKS, D., MITCHESON, M., OGBORNE, A., and EDWARDS, G. (1969). 'Abuse of methylamphetamine', *Br. med. J.* **i**, 715–21.

EDWARDS, G. (1970). 'The place of treatment professions in society's response to chemical abuse', ibid. **2**, 195–9.

MITCHESON, M., DAVIDSON, J., HAWKS, D., HITCHINS, L., and MALONE, S. (1970). 'Sedative abuse by heroin addicts', *Lancet*, **i**, 606–7.

RUSSELL, M.A.H. (1970). 'Effects of electric aversion on cigarette smoking', *Br. med. J.* **1**, 82–6.

STIMSON, G., and OGBORNE, A. (1970). 'Survey of addicts prescribed heroin at London clinics', *Lancet*, **i**, 1163–6.

6

NEWELL, D.J. (1970). 'Hospital bed usage', *Br. J. hosp. Med.* **13**, 915–17.

WALKER, J.H., SMITH, A., and IRVINE, D.H. (1971). 'Vocational training for general practice: a preliminary report', *Br. med. J.* **1**, 41–3.

8

HOLLAND, W.W., and BENNETT, A.E. (1968). 'The medical record and the computer. Part I. The selection of input', in McLachlan, G., and Shegog, R.A. (eds), *Computers in the Service of Medicine*, vol. ii, chap. 18 (Oxford University Press for the Nuffield Provincial Hospitals Trust).

—— and DEANE, M. (1968). 'The medical record and the computer. Part II. Information analysis', ibid. vol. ii, chap. 19.

—— and ELLIOTT, A. (1968). 'Cigarette smoking, respiratory symptoms and anti-smoking propaganda: an experiment', *Lancet*, **i**, 41.

—— BENNETT, A.E., DEANE, M., and ELLIOTT, A. (1968). 'The care of old people in residential homes', *Br. J. prev. soc. Med.* **22**, 193.

—— HALIL, T., and ELLIOTT, A. (1968). *The Effect of Environmental Factors on Ventilatory Function in Schoolchildren*, P.H.S. publication no. 1879, p. 259.

CLARKE, M., PEREIRA, M.S., and MILLER, D.L. (1969). 'Serological evidence of infection with A2 Hong Kong influenza virus during the epidemic in Britain 1968–1969', *Br. med. J.* **4**, 815.

GARRAD, J. (1969). 'The right to die', *Maapskaplike Werk* (*Social Work*), **5**, 115.

HOLLAND, W.W., HALIL, T., BENNETT, A.E., and ELLIOTT, A. (1969). 'Indications for measures to be taken in childhood to prevent chronic respiratory disease', *Milbank meml Fund q.* **47**, 215.

—— 'Vital statistics', in Bodley-Scott, R., and Milnes-Walker, R. (eds), *Medical Annual*, chaps. 1969, 1970. (Bristol: J. Wright & Sons).

—— (1969). 'The laboratory and patient records', *J. Clin. Pathol.* **22**, 57. suppl. 3.

—— KASAP, H.S., COLLEY, J.R.T., and CORMACK, W. (1969). 'Respiratory symptoms and ventilatory function: a family study', *Br. J. prev. soc. Med.* **23**, 77.

—— HALIL, T., BENNETT, A.E., and ELLIOTT, A. (1969). 'Factors influencing the onset of chronic respiratory disease', *Br. med. J.* **2**, 205.

KASAP, H.S. (1969). 'Packages and programmes', in Abrams, M.E. (ed.), *Medical Computing—Progress and Problems* (British Computer Society).

PALMER, J.W., KASAP, H.S., BENNETT, A.E., and HOLLAND, W.W. (1969).' The use of hospitals by a defined population', *Br. J. prev. soc. Med.* **23**, 91.

HOLLAND, W.W., and TREVELYAN, M.H. (1969). 'The value of surveillance and multiphasic screening', *Proc. of the 8th International Congress of Gerontology*, vol. 1 (Institute of Gerontology).

BENNETT, A.E., DOLL, R., and HOWELL, R.W. (1970). 'Sugar consumption and cigarette smoking', *Lancet*, **i**, 1011.

—— GARRAD, J., and HALIL, T. (1970). 'Chronic disease and disability in the community: a prevalence study', *Br. med. J.* **3**, 762.

—— (1970). 'The medical implications of computers', *Br. J. hosp. Med.* **3**, Suppl. 1 and *Medical Record*, **11**, 44.

—— and KASAP, H.S. (1970). 'Data processing for a private census', in Holland, W.W. (ed.), *Data Handling in Epidemiology* (Oxford Medical Publications).

HOLLAND, W.W. (1970). 'Principles of study design', ibid.

—— (1970). 'Experiences of medical care in the United States', *Lancet*, **i**, 202.

BENNETT, A.E., and HOLLAND, W.W. (1970). 'Computers, mathematics and medicine', *Internat. J. of Math. Educ. in Sci. & Technol.* **1**, 69.

GARRAD, J., and ROSENHEIM, M. (1970). *Some Aspects of Clinical Medicine* (London: Ballière, Tindall and Cassell).

HOLLAND, W.W. (1970). 'Populations for Surveys', in Waibel and Widmer (eds), *Epidemiologie Kardiovaskulaer Krankheiten* (Bern: Verlag Hans Huber).

MORRELL, D.C., GAGE, H.G., and ROBINSON, N.A. (1970). 'Patterns of demand in general practice', *Jl R. Coll. Gen. Practit.* **19**, 331.

HOLLAND, W.W., BENNETT, A.E., MORRELL, D.C., GARRAD, J., and COLLINS, J. (eds) (1970). *Resources in Medicine* (King Edward's Hospital Fund for London).

TOPP, S.G., COOK, J., HOLLAND, W.W., and ELLIOTT, A. (1970). 'The influence of environmental factors on the height and weight of school children', *Br. J. prev. soc. Med.* **24**, 154.

MEDICAL RESEARCH PROGRAMMES

9

KNOX, E.G., and MAHON, D.F. (1970). 'An evaluation of "infant at risk" registers', *Archives of Disease in Childhood*, **45**, 634.

11

ANDERSON, J.A.D., and DRAPER, P. (1969). 'The future of the health visitor', *Medical News*, 4 April.

—— —— KINKAID, H.I.T., and AMBER, M.C. (1970). 'Attachment of community nurses to general practices: a follow-up study', *Br. med. J.* **4**, 103–5.

—— COGHILL, N.F., KNOWLES, G.S.A., PINDER, R.M., REVANS, R.W., and ULYATT, F.M. (1971). 'The consultant's role in hospital management', *Med. Offr*, **125**, 73–6.

13

SLACK, G.L. *et. al* (1970). *Adult Dental Health in England and Wales in 1968* (London: HMSO).

14

SLACK, G.L. (1969). *Proposals for Planned Changes in Dental Education, The London Hospital Medical College Dental School* (The London Hospital Medical College).

15

LOGAN, R.L.F. (1969). 'Some problems in medical care', *Medical Annual*, **2**, 20–34.

—— KLEIN, R.E., and GRIFFITHS, D.A.T. (1970). 'Paying for medical care: need for debate', *Lancet*, **ii.** 647–9.

BUTLER, J.R., and PEARSON, M. (1970). *Who goes home?* Occasional Papers on Social Administration, no. 34.

LOGAN, R.L.F. (1970). 'The aged in Britain', *Inter-Discipl. Topics Geront.* **5**, 83–92 (Basel, Munich, New York: Karger).

—— PAKER, P., and KLEIN, R. (1971). 'Patients as consumers', *Br. J. hosp. Med.* **5**, 1.

18

COOPER, B. (1966). 'Psychiatric disorder in hospital and general practice', *Soc. Psychiat.* **1**, 7–10.

KEDWARD, H.B., and COOPER, B. (1966). 'Neurotic disorders in urban practice: a three year follow-up', *Jl R. Coll. Gen. Practit.* **12**, 148–62.

SHEPHERD, M., COOPER, A.B., BROWN, A.C., and KALTON, G.W. (1966). *Psychiatric Illness in General Practice* (Oxford University Press).

COOPER, B., and BROWN, A.C. (1967). 'Psychiatric practice in Great Britain and America: a comparative study', *Br. J. psychiat.* **113**, 625–36.

BLACKWELL, B., and GOLDBERG, D.P. (1968). 'Psychiatric interviews in general practice'. *Br. med. J.* **4**, 99–101.

COOPER, B. (1968). 'Recent progress in epidemiological psychiatry', *Postgrad. med. J.* **44**, 331–5.

GATH, D. (1968). 'Child guidance and the general practitioner', *J. Child. Psychol. Psychiat.* **9**, 213–27.

KALTON, G. (1968). 'The contribution of research in general practice to the study of morbidity', *Jl R. Coll. Gen. Practit.* **15**, 81–95.

ABRAHAMSON, D. (1969). 'Untreated psychiatric morbidity: a general practice study', *Soc. Psychiat.* **4**, 5–11.

COOPER, B., FRY, J., and KALTON, G. (1969). 'A longitudinal study of psychiatric morbidity in a general practice population. *Br. J. prev. soc. Med.* **23**, 210–17.

EASTWOOD, M.R. (1969). 'The identification and screening of psychiatric disorder within the general population', *Pakistan Med. Rev.* **3**, 53–56.
HOPKINS, P., and COOPER, B. (1969). 'Psychiatric referral from a general practice', *Br. J. psychiat.* **115**, 1163–74.
KEDWARD, H. (1969). 'The outcome of neurotic illness in the community', *Soc. Psychiat.* **4**, 1–4.
SYLPH, J., KEDWARD, H.B., and EASTWOOD, M.R. (1969). 'Chronic neurotic patients in general practice: a pilot study', *Jl R. Coll. Gen. Practit.* **17**, 162–70.
GOLDBERG, D., COOPER, B., EASTWOOD, M.R., KEDWARD, H.B., and SHEPHERD, M. (1970). 'A standardised psychiatric interview for use in community surveys', *Br. J. prev. soc. Med.* **24**, 1, 18–23.
HARVEY-SMITH, E.A., and COOPER, B. (1970). 'Patterns of neurotic illness in the community', *Jl R. Coll. Gen. Practit.* **19**, 132–9.
PEDDER, J.R., and GOLDBERG, D.P. (1970). 'A survey by questionnaire of psychiatric disturbance in patients attending a venereal diseases clinic', *Br. J. Vener. Dis.* **46**, 58–61.
SHEPHERD, M., and COOPER, B. (1165). 'Interchange, stress and mental disorder' in Harding Price, J. (ed.), *Modern Trends in Psychological Medicine*, pp. 102–30, Butterworth.
GOLDBERG, D.P., and BLACKWELL, B. (1970). 'Psychiatric illness in general practice: a detailed study using a new method of case identification', *Br. med. J.* **2**, 439–43.
—— (1970). 'A psychiatric study of patients with diseases of the small intestine', *Gut*, **11**, 459–65.
SHEPHERD, M., GOLDBERG, D.P., EASTWOOD, M., COOPER, B., and SYLPH, J. (1970). 'Psychiatric epidemiology and general practice', in Hare, E.H., and Wing, J.K. (eds), *Psychiatric Epidemiology*, pp. 281–309 (Oxford University Press).
HARWIN, B.G., COOPER, B., EASTWOOD, M., and GOLDBERG, D.P. (1970). 'Prospects for social work in general practice', *Lancet*, **ii**, 7672.
EASTWOOD, M. (1971). 'Smoking and neurotic illness', ibid. **i**, 107–8.

20

BYRNE, P.S., and FREEMAN, J. (1970). 'Vocational training for general practice; some problems of implementation', *Br. J. med. Educ.* **4**, 4, 268–73.
—— and M'COMISKY, J.G. (1970). 'General practitioners observed: a study of personality, intellectual factors, and group behaviour', ibid. **4**, 3, 176–84.

22

CAMPBELL, A.C. (1968). 'Characteristics of 352 residents and 119 ex-residents of 14 Lancashire County Council hostels for mentally disordered adults', *Med. Offr*, **119**, 1, 3–6.
—— (1968). 'Attitudes of mentally disordered adults to community care', *Br. J. prev. soc. Med.* **22**, 2.
—— (1968). 'Comparison of family and community contacts of mentally subnormal adults in hospital and in local authority hostels', ibid. **22**, 3.
—— (1968). 'The preventive use of mental health hostels', *Med. Offr*, **120**, 10, 137–9.
—— (1969). 'Family contacts of mentally subnormal and severely subnormal adults in local authority hostels', ibid. **122**, 14, 183–4.

FRYERS, T., FREEMAN, H.L., and MOUNTNEY, G.H. (1970). 'A census of psychiatric patients in an urban community', *Soc. Psychiat.* **5**, 4, 187–95.

23

MITTLER, P.J. (ed.) (1970). 'The work of the Hester Adrian Research Centre: A report for teachers', Monograph supplement to *Teaching and Training*, **8**, 47.

24

ELWOOD, P.C., NEWTON, D., EAKINS, J.D., and BROWN, D.A. (1968). 'The absorption of iron from bread', *Am. J. clin. Nutr.* **21**, 1162–9.

—— (1968). 'Some epidemiological problems of iron deficiency anaemia', *Proc. Nutr. Soc.* **27**, 1, 14–23.

—— WATERS, W.E., and GREENE, W.J.W. (1970). 'Evaluation of iron supplements in prevention of iron deficiency anaemia', *Lancet*, **ii**, 175.

WEDDELL, J.M. (1969). 'Varicose veins pilot survey 1966', *Br. J. prev. soc. Med.* **23**, 3, 179.

—— (1969). 'A comparison of two methods in the treatment of varicose veins', *XIII Annual Meeting of the Society for Social Medicine*, 1969.

—— FURNIVAL, I.G., STEWART, H.J., DOVEY, P., GRABELLE, I.H., EVANS, K.T., and FORREST, A.P.M. (1970). 'Accuracy of screening methods for the diagnosis of breast disease', *Br. med. J.* **4**, 461.

—— and ELWOOD, P.C. (1971). 'Epidemiology of some common conditions', *Br. med. Bull.* **27** (1), 32.

25

WING, L. *et al.* (1967). 'The use of psychiatric services in three urban areas: an international case register study', *Soc. Psychiat.* **2**, 158–67.

WING, J.K., and WING, L. (1970). 'Psychotherapy and the National Health Service', *Br. J. psychiat.* **116**, 51–5.

WING, L., BRAMLEY, C., HAILEY, A., and WING, J.K. (1968). 'Camberwell cumulative psychiatric case register Part I: Aims and methods', *Soc. Psychiat.* **3**, no. 3, 116–23.

HAILEY, A., WING, L., and WING, J.K. (1970). 'Camberwell psychiatric case register Part II: Basic data required for planning', ibid. **15**, no. 4, 195–202.

FRYERS, T., FREEMAN, H.L., and MOUNTNEY, G.H. (1970). 'A census of psychiatric patients in an urban community', ibid. **5**, no. 4, 187–94.

26

KAY, D.W.K., ROTH, M., and HALL, M.R.P. (1966). 'Special problems of the aged and the organization of hospital services', *Br. med. J.* **2**, 967–72.

BOLTON, N., SAVAGE, R.D., and ROTH, M. (1967). 'The modified work learning test and the aged psychiatric patient', *Br. J. psychiat.* **113**, 1139–40.

BRITTON, P.G., and SAVAGE, R.D. (1968). 'The factorial structure of the WAIS on an aged sample', *J. Geront.* **23**, 2, 183–6.

—— —— (1969). 'The factor structure of the MMPI in an aged population', *J. Genet. Psychol.* **114**, 13–17.

KAY, D.W.K. (1969). 'Follow-up of a community sample of the aged: The possibility of predicting psychiatric illness', *J. Lpool Psychiat. Soc.* **6**, 2, 19–26.

—— BERGMANN, K., FOSTER, E.M., MCKECHNIE, A.A., and ROTH, M. (1970). 'Mental illness and hospital usage in the elderly: A random sample followed up', *Comprehens. Psychiat.* **11**, 26–35.
—— (1970). 'Senility', *Community Health*, **2**, 3, 127–32.
BERGMAN, K. (1971). 'The neuroses of old age: Epidemiological aspects', in Kay, D.W.K., and Walker, D.E. (eds), *Recent Developments in Psychogeriatrics*, *Br. J. psychiat.* Special publications no. 6.

27

LEONARD, J.A. (1963). 'Mobility of the blind: a survey', *Med. electron. biol. Engng*, **1**, 465–81.
—— and CARPENTER, A. (1964). 'Trials of an acoustic aid', *Research Bulletin. American Foundation for the Blind*, **4**, 70–119 (New York).
—— and DAVIDSON, L.A. (1965). 'Digital read-out device for blind people', *Med. electron. biol. Engng*, **3**, 441–2.
—— and WYCHERLEY, R.J. (1966). 'Stopping distance as a function of speed in blindfold walking', *Bull. Br. psychol. Soc.* **20**, 7 (A).
—— (1966). 'Towards a unified approach to the mobility of blind people', *Southern Regional Rev. Ass. for the Blind, London*, **40**, 1–14.
—— (1966). 'Aid to navigation: a discussion of the problems of maps for blind travellers', *Sensory Devices for the Blind*, 9–29 (London: St Dunstans).
—— (1967). 'Mobility as a school subject', *Teacher of the Blind*, **55**, 102–7.
—— and NEWMAN, R.C. (1967). 'Spatial orientation in the blind', *Nature, Lond.* **215**, 5108, 1413–14.
—— —— (1967). 'A comparison of 3 types of portable route maps for blind travel', *Bull. Br. psychol. Soc.* **21**, 34 (A).
—— (1968). 'Mobility of the blind: the stage now reached by research', *Conference Report*, **57** (London: Southern Region Association for the Blind).
WYCHERLEY, R.J., and NICKLIN, B. (1968). 'The heart rate of the blind and sighted pedestrians on a town route', *Ergonomics*, **13**, 181–92.
LEONARD, J.A., and WYCHERLEY, R.J. (1968). 'Measurement of the performance of travel skill', *Conf. proc. MIT 1967*, 27–45.

29

BENNETT, A.E. (1970). 'Migration in an urban population (summary)', *Br. J. prev. soc. Med.* **24**, 63.

For other publications see 8.

30

For list of references see Part II, pp. 157–60.

31

CROMBIE, D.L. (1965). 'A career structure for general practitioners', Reprint from *Lancet*, **i**, 368–70.
—— (1969). 'N-tuplets in computer diagnosis', *Jl R. Coll. Gen. Practit.* **18**, 219.
—— and PINSENT, R.J.F.H. (1969). 'Medical records in general practice', *Health Trends*.
—— (1970). 'Group dynamics and the domiciliary health team', *Jl R. Coll. Gen. Practit.* **19**, 66.

HUTCHINSON, M. (1969). 'How patients get to the surgery', ibid. **18,** 95.
PINSENT, R.J.F.H. (1967). 'A framework for effective health care', ibid. **14,** 331.
—— (1969). 'Continuing care in general practice', ibid. **17,** 223.
—— (1968). 'The evolving age-sex register', ibid. **16,** 127.
—— (1970). 'Some characteristics of a family', *J. Biosoc. Sci.* **2,** 199–212.
RESEARCH UNIT (1965). 'Research Method—A Family Record Card.'
RECORDS AND STATISTICS UNIT (1968). '"E" book diagnostic index-recording instructions' (rev. October 1965).
——(1966). 'Some contrasts in morbidity distribution', *Jl R. Coll. Gen. Practit.* **1,** 74.
—— (1966). 'The analysis of routine medical records', ibid. **11,** no. 1, 34/40.
RECORDS UNIT (1967). 'Oral contraception and thrombo-embolic disease. Report of the Records Unit and Research Advisory Service of the Royal College of General Practitioners', ibid. **13,** 267.
RECORDS AND RESEARCH ADVISORY SERVICES (1967). 'The "L" Book', ibid. **14,** 289.
WILLIAMS, W.O. (1970). 'A study of general practioners work load in S. Wales, 1965–6' (Reports from General Practice no. XII). Supplement to *Jl R. Coll. Gen. Practit.*
WRIGHT, H.J. (1968). 'General practice in S.W. England', ibid.

Other studies in which the assistance of the Unit (U), Dr Crombie (C), Mrs Jones (J), Dr Pinsent (P), or the College's Research Foundation (RF), are acknowledged.

CARR, T. (1967). 'Report of a survey of hospital admissions by the S.E. England faculty', *Jl R. Coll. Gen. Practit.* **14,** 294 (U) (J).
MARINKER, M. (1967). 'Studies of contact behaviour in a general practice', ibid. **14,** 59 (RF) (C) (P).
—— (1969). 'The general practitioner as family doctor', ibid. **17,** 227 (J).
MILLER, D.L., and LEE, J.A. (1969). 'Influenza in Britain 1967–1968', *J. Hyg. Camb.* **67,** 559 (C) (J).
PIKE, L.A. (1969). 'Health education in general practice', *Jl R. Coll. Gen. Practit.* **17,** 133 (P) (J).
—— (1969). 'A screening programme for the elderly in general practice', *The Practitioner* (P).
RESEARCH UNIT (1969). 'A transatlantic morbidity survey', *Jl R. Coll. Gen. Practit.* **18,** 137 (C) (P) (J).
WORLD HEALTH ORGANIZATION (1969). *Weekly Epidemiological Record,* **44,** 605–12 (U).
DRURY, M., and KUENSSBERG, E.V. (1970). 'Inquiry into administrative activities in general practice', *Br. med. J.* **4,** 42–4 (C) (J).

32

MORRIS, D., WARD, A.W.M., and HANDYSIDE, A.J. (1968). 'Early discharge after hernia repair', *Lancet,* **i,** 681–5.
WARD, A.W.M., and CARTWRIGHT, A. (1968). 'Variations in general practitioners' response to postal questionnaires', *Br. J. prev. soc. Med.* **22,** 199.
—— (1969). 'General practitioners and family planning in Sheffield', *J. Biosoc. Sci.* **1,** 15–22.
—— (1969). 'Family planning clinics in Sheffield 1967', ibid. **1,** 207–19.
MORRIS, D., and HANDYSIDE, A.J. (1967). 'Simulation of emergency bed occupancy', *Health Services Research,* **1** (Fall–Winter), 287–97.
—— HALL, G.A., and HANDYSIDE, A.J. (1969). 'Admissions from surgical waiting lists', *Br. J. prev. soc. Med.* **23,** 233–40.

SOCIAL RESEARCH PROGRAMMES

95

SUMNER, G., and SMITH, R. (1969). *Planning Local Authority Services for the Elderly* (Allen & Unwin).

—— (1966). 'Studies of hospital out-patients services: hospitals in the North-East Scotland Region', *Problems and Progress in Medical Care*, Second Series, McLachlan, G. (ed.) (Oxford University Press for the Nuffield Provincial Hospitals Trust).

EDWARDS, J. *et al.* (1966). *Social Patterns in Birmingham*, Occasional paper 13 (Centre for Urban and Regional Studies).

96

CLARKE, MAY (1969). *Trouble with Feet*. Occasional paper on social administration, no. 29 (London: G. Bell & Sons).

97

BUTLER, J.R., and PEARSON, M. (1970). *Who goes Home? A Study of Long-stay Patients in Acute Hospital Care*. Occasional papers on social administration, no. 34 (London: G. Bell & Sons).

—— (1970). 'Illness and the sick role: an evaluation in three communities', *Br. J. Soc.* **21**, no. 3, 241–61.

BEVAN, J.M., and DRAPER, G. (1967). *Appointment Systems in General Practice* (Oxford University Press for the Nuffield Provincial Hospitals Trust).

—— —— (1965). 'Sampling problems in studies of general practice', *Medical Care*, **3**, no. 3.

DAWES, K.S., and BROWN, I.D. (1961). 'Treatment of psychoneurotic depressed patients with tranylepromine trifluoperazine jointly', *Med. Observer*.

—— (1970). 'The changing face of a Tyneside general practice', *Modern Management*, **1**, no. 3.

98

JEFFERYS, M., MELLARD, J.B., HYMAN, M., and WARREN, M.D. (1969). 'A set of tests for measuring motor impairment in prevalence studies', *J. chron. Dis.* **22**, 303–19.

99

TIZARD, B., and TIZARD, JOSEPH A. (1970). 'The cognitive development of young children in residential care', *J. Child Psych. and Psychiat.* (December).

—— —— (1970). 'Today's foundlings: a survey of young children admitted to the care of voluntary societies in England', *New Society*, **16**, 585.

—— —— (1971). 'The social development of 2-year-old children in residential nurseries', in *The Origin of Human Social Relations* (Academic Press).

100

KUSHLICK, A. (1965). 'A plan for Experimental Evaluation', *Proc. R. Soc. Med.* **58**, no. 5, 374–80.

—— (1966). 'A community service for the mentally subnormal', *Soc. Psychiat.* **1**, no. 2, 73–82.
—— (1967). 'A method of evaluating the effectiveness of a community health service', *Soc. Econ. Admin.* **1**, no. 4, 29–48.
—— (1967). 'The Wessex experiment: comprehensive care for the mentally subnormal', *Br. Hosp. J. and Soc. Service Rev.* **77**, 1889–92.
—— and Cox G. (1970). *Planning Services for the Subnormal in Wessex*, in Department of Health and Social Security—Statistical Report Series no. 8, p. 23 (HMSO).
—— (1970). 'Residential care for the mentally subnormal', *J. R. Soc. Hlth*, **90**, no. 5, 255–61.

102

ALBERMAN, E.D., and GOLDSTEIN, H. (1970). 'The "at risk" register. A statistical evaluation', *Br. J. prev. soc. Med.* **24**, 3.
DAVIE, R., BUTLER, N.R., and GOLDSTEIN, H. (1971). *From Birth to Seven* (Longmans in association with the National Children's Bureau).
—— (1968). 'The first follow-up of the children born in the control week', *Perinatal Problems* (Edinburgh: E. & S. Livingstone).
PRINGLE, M.L., and KELLMER (ed.) (1969). *Caring for Children* (Longmans in association with the National Children's Bureau).
—— —— (1969). *Planning and Programming for Child Care* (San Rafael, California, USA: Academic Therapy Publications).
—— —— (1970). *The Behaviour and Adjustment of 7-year-olds in England, Scotland and Wales*, (Edinburgh: Scottish Educational Studies). **2**, 3–10.
—— —— CRELLIN, E., and WEST, P. (1971). *Born Illegitimate* (Longmans in association with the National Children's Bureau).

103

For list of references see Part II, pp. 99—108.

105

MILLER, E.J., and GWYNNE, G.V. *A Life Apart: A Report of a Pilot Study of Residential Institutions for the Physically Handicapped and Young Chronic Sick* (Tavistock Publications: forthcoming).

106

STACEY, M., DEARDEN, R., PILL, R., and ROBINSON, D. (1970). *Hospitals, Children and their Families* (London: Routledge and Kegan Paul).
SKULTONS, V. (1970). 'The symbolic significance of menstruation and menopause', *Man*, **5**, no. 4.
PILL, R. (1969). 'Space and social structure in 2 children's wards', *Sociol. Rev.* **15**, no. 2.
ROBINSON, D., and PILL, R. (1969). 'Implementing official policy: living in, unrestricted visiting, and the wellbeing of children in hospital', *Soc. Econ. Admin.* no. 3.
—— (1968). 'Mothers' fear, their children's wellbeing in hospital and the study of illness behaviour', *Br. J. prev. soc. Med.* **4**, no. 22.
—— (1968). 'A note on hospital orientation', *Med. Offr*, no. 6, 3133.

—— (1968). 'Parents' satisfaction with in-hospital information about their children', *Nursing Times*, **66**.
—— (1970). 'When the patient is a young child', *J. Inst. Hlth Educ.* **8**, 1.
—— (1971). 'Becoming a patient: mothers' attitudes towards tonsillectomy', *Med. Offr*, **125**, no. 3.

OPERATIONAL AND MANAGEMENT RESEARCH PROGRAMMES

129

SINGH, A. (1963). 'Interests, values and personality traits of students specializing in different fields of study in university', *Educ. Rev.* **21**, no. 1, 41–55.
MACGUIRE, J.M. (1969). *Threshold to Nursing*, Bell & Sons Booklet no. 30.
—— (1970). 'Attrition from nursing training, Part I', *Internat. Nursing Rev.* **17**, no. 1.
—— (1970). 'Attrition from nursing training, Part II', ibid. **17**, no. 2.
—— (1970). 'Nurses and graduates I: An attempt to locate nurses with degrees', *Nursing Times* (pull-out) **66**, 14.
—— (1970). 'Nurses and graduates II: An attempt to locate nurses with degrees', ibid. **66**, 15.
—— and SPARKES, S. (1970). 'The nurse/graduate in the United Kingdom: Patterns of Qualifications', *Internat. Nursing Rev.* (October) **17**, no. 4.
SINGH, Dr A. (1970). 'The student nurse on experimental courses I: Attitudes toward nursing as a career', *Internat. J. Nursing Stud.* **7**, 201–24.
(1970). 'Applications and admissions form printed as an occasional paper', *Nursing Times* (pull-out) **66**, 45.

131

LUCK, G.M. (1968). 'The sister's role in ward management', *Nursing Times*, **64**, 49, 1654–6.
—— (1969). 'Management of surgery and operating theatres', *J. Nat. Ass. Theatre Nurses*, **6**, 3, 19–25.
LUCKMAN, J., MACKENZIE, M., and STRINGER, J. (1969). *Management Policies for Large Ward Units* IOR Health Report no. 1 (I.O.R. and Research Publ. Ltd).
—— (1971). *Planning Surgery: A Computer Simulation.*
LUCK, G.M., and STRINGER, J. (1970). *Hospital Operational Policies at the Commissioning Stage.* IOR Health Report no. 3.
SMITH, B.W., and LUCK, G.M. (1969). *Networks for the Commissioning of Walsgrave Hospital, Coventry.* IOR Health Report no. 4.
SPENCER, P. (1971). *General Practice and Models of the Referral Process.* IOR Health Report no. 6.

133

HINDLE, A. (1970). *A Simulation Approach to Surgical Scheduling* (University of Lancaster) (August).

134

CATERING RESEARCH UNIT (1970). *An Experiment in Hospital Catering using the Cook-Freeze System* (University of Leeds and the United Leeds Hospitals).

GLEW, G. (1970). 'Pre-cooked frozen food in hospital catering', *R. Soc. Hlth J.* **90**, 3.

HILL, M.A., and GLEW, G. (1969). 'The development of recipes for a pre-cooked frozen food catering system for use in hospitals—1. General diet', *Nutrition Lond.* **23**, 68–78.

—— —— CONRY, A., COCHRANE, J., BAGULEY, J.E., and WALKER, C. (1970). 'The development of recipes for a pre-cooked frozen food catering system for use in hospitals—2. Special diet', ibid. **24**, no. 1, 12–18.

—— —— (1970). 'The effect of delay between cooking and freezing on the flavour of pre-cooked frozen food', *J. Food Technol.* **5**, 187–91.

WALKER, R.B., and GLEW, G. (1969). 'Forced convection ovens for re-heating pre-cooked frozen food', ibid. **4**, 307–18.

138

MCFARLANE, J.K. (1970). 'Study of nursing care: The first two years of a research project', *Internat. Nursing Rev.* **17**, 2, 101–8.

Subject index

List of personal names

List of research activities where no person is named