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THE FOUNDATIONS OF RESEARCH IN PSYCHIATRY*

BY

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Research and treatment in psychiatry are founded upon a tripod, whose three legs can be regarded as the study of the patient's basic constitution and personality, of his physical exchanges with his environment, and of the various mental stresses to which the pattern of his life submits him. These three are probably equally indispensable in the pursuit of knowledge about the mental health or sickness of mankind, and are indeed ultimately only aspects of the underlying and mysterious unity which is man himself. From a technical point of view it is often convenient and sometimes essential to attack the problems of their study separately and piecemeal: but only by constant and patient correlation of all the results in every field can true advance be made.

Basic Constitution and Personality

Constitutional studies include investigation of the relationship between the structural and innate functional patterns, characteristic of various types of human being, and their personality and way of living. For example, very valuable work has already been done in correlating body build and various types of brain and glandular activity, with different types of personality, and different ways of meeting adversity, such as mental breakdown or criminal behaviour, throughout childhood and adult life. The study of what has been called psychopathic personality has made a significant stride forward in this way.

Innumerable definitions of psychopathic personality have been attempted, but one which serves to focus interest on productive possibilities in clinical research in this field regards the basic abnormality in the psychopath as a failure to develop emotionally beyond the explosive behaviour and immediately sought gratification of infantile life. This failure of emotional development, as is well known, may be specific in the sense that there is no comparable failure of intellect or of physical development. A piece of research in which much attention was paid to the possibility of defining those aspects of psychopathic personality that could be clinically measured has shown that there is a consistent, high, and significant correlation between the clinical behaviour of the individuals concerned and the pattern of electrical activity recorded from their brains by the electroencephalogram (Stafford-Clark *et al.*, 1951).

Further patient and detailed study of the individuals' behavioural and structural patterns revealed that their infantile reaction to the stresses of life could also be

significantly correlated with an infantile pattern of distribution and structure even of the capillary loops, which can be observed under the microscope at the growing base of the finger-nail in all human beings. Just as the psychopath behaves like an overgrown and perhaps intelligent baby, so do his electrical patterns of brain activity and the loops of his capillaries show many of the characteristics of babyhood. Interest in the significance of abnormal patterns of electrical activity in the brain in relationship to patterns of adult behaviour, and particularly those which seem to arise on a constitutional basis, has led to findings in which disordered behaviour can be in many instances directly correlated with abnormalities in the E.E.G. record.

E.E.G. in Relation to Abnormal Behaviour

If we take a random sample of the adult population, calling an adult for the purpose of this definition anyone over the age of 21, we can recognize that the overall wave forms of the E.E.G.s of 85% of the population will be relatively consistent, uniform, and similar. Some 15% of the records will, however, contain significant abnormalities. These abnormalities can be fairly readily divided into groups: those which can be directly correlated with some damage or abnormality of brain structure—for example, tumour or abscess in the brain—and those which are related to disturbance of function without demonstrable structural disorder. This latter category can again be subdivided into abnormal patterns associated with specific clinical disturbance of brain function, such as the various forms of epilepsy, and abnormal patterns which, because they have not in the past been regarded as corresponding to any specific disorder of behaviour, have been noted as abnormal without being recognized as specifically significant in any way. These are called non-specific abnormalities, and make up quite a large proportion of the 15% of abnormalities seen in the population as a whole. They include changes in the rate and rhythm of the brain waves of a kind which are normal in infancy but become progressively less frequent as the brain matures.

The following table has been constructed from the pooled findings of a number of observers, all of whom studied the E.E.G. in relation to explosive or abnormal behaviour in otherwise normally endowed people. The studies made by my own group on psychopaths are included in this table, which is set out in terms of percentage of abnormality in the E.E.G.s of the subject studied, correlated with the particular type of population submitted to this study.

*Based on an address delivered to the Annual General Meeting of the Mental Health Research Fund on March 18, 1959.

Category	Abnormal E.E.G. %	
Highly selected flying personnel	5	(Williams, 1941)
R.A.M.C. personnel	10	(Williams, 1941)
Mixed controls	15	(Hill and Watterson, 1942)
Controls in prison	25	(Stafford-Clark <i>et al.</i> , 1951)
Mixed psychoneurotics ..	26	(Williams, 1941)
Inadequate psychopaths ..	32	(Hill and Watterson, 1942)
Aggressive psychopaths ..	65	(Hill and Watterson, 1942)
Motiveless murderers ..	73	(Stafford-Clark and Taylor, 1949)
Aggressive psychopaths in prison	83	(Stafford-Clark <i>et al.</i> , 1951)

Viewed in this way, a number of points stand out, demanding recognition and stimulating further inquiry. It will be noticed that the first two categories of population studied have a lower incidence of abnormality in their E.E.G.s than the random sample of population to which we first referred. These two groups are respectively aircrews selected for operational service with the R.A.F. during the war, and Army personnel from the Royal Army Medical Corps. In neither case, of course, were E.E.G. records available as an aid to selection in the first place. The selection of aircrew was based on an assessment of relatively perfect physical and mental health, as judged on clinical examination, coupled with the optimum age for withstanding the stresses of flying. The R.A.M.C. group, while less rigorously selected, were still young fit men and women, selected and recruited for a special task.

When we pass beyond the normal population we find that the first group to show a consistent increase in the percentage of abnormality of their E.E.G. records, expressed, like all these figures for the purpose of this lecture, in round figures, are the prison population. Mental hospitals show a further increase, and the overall group of psychopaths specifically studied in prison, who form in fact about 5% of the prison population, a further increase still. But perhaps the most important single figure here is that of the 73% incidence of abnormality in the records of the people whom I have called motiveless murderers (Stafford-Clark and Taylor, 1949).

E.E.G. Findings in Murderers

The research out of which this particular finding grew cannot be recapitulated in detail here. Suffice it to say that it was a careful study of the E.E.G. findings in a series of prisoners all of whom had one thing, but only one thing, in common: that they were charged with the crime of murder. Faced by two sets of data of this kind, it is the task of clinical research to discover what are the questions inherent in the findings that may lead to significant answers. We were lucky in this particular piece of research because we hit upon what subsequently proved to be an exceedingly significant question simply by reviewing the history and personal circumstances of each individual in terms of the crime with which he or she was charged. We were in this way able to make a number of separate clinical categories, each of which could be studied separately in terms of the E.E.G. records of the particular group.

These categories included what we called accidental murderers, people who had been involved in action resulting in loss of life while already engaged upon the commission of a felony, and who, while indisputably criminal, were not necessarily to be regarded as wilful murderers at all. A second category was that of deliberate motivated murder: people who had committed murder for reasons which they and everyone else concerned could relate to the basis of the crime.

Two important categories remained: motiveless murderers, who had committed sudden explosive acts of violence causing the death of another person for no reason which they or anyone else could put forward; and the people who were at the time of the killing recognizably insane.

The group of murderers whose crime was regarded as incidental or even accidental in the course of the commission of another felony showed a 25% incidence of E.E.G. abnormality—equal, in fact, to that of the prison population as a whole. In those who had committed a murder under the stress of considerable personal provocation, and were to this extent clearly motivated, the proportion of abnormality was roughly 17%; considerably below the average for the prison population as a whole and not very much above that of the ordinary population chosen at random. But in the apparently motiveless murderers, the people who exploded into an act of violence without any kind of provocation other than perhaps the immediate stress of sexual excitement, resentment, or exhaustion, the percentage of abnormality was 73, the highest recorded in any group of individuals selected in any way, if one excludes known epileptics who have committed a crime or patients with rare but explosive forms of insanity who have also given way to acts of violence.

It is necessary, of course, to keep a sense of proportion about the meaning of these findings. One has to remember that these are only percentages of abnormality within a group. One-quarter even of the motiveless murderers had perfectly normal E.E.G. records. But nevertheless the tendency to commit an apparently motiveless act of extreme violence, explosively and unpredictably, does seem to be linked with a particular kind of instability and immaturity of brain function which can be objectively recognized and recorded. Clearly our researches in this direction still represent little more than a groping after the most shadowy outlines of truth, but a groping which may be rewarded by increasing definition as we learn to pool and interpret our results in terms of clinical study correlated with increasingly accurate measurement of our findings.

Genetics

Another aspect of constitutional studies which opens up immense possibilities for future understanding is the science of genetics; the tracing and measurement of probabilities in inheritance of both structural and personality characteristics from one generation to another. Our knowledge of schizophrenia and of homosexuality has been profoundly affected in this way.

Evidence of the importance of the constitutional factor in these two disorders has been provided by studies of identical and non-identical twins. Relatively large-scale inquiries in which the life-history of each of a pair of identical twins has been followed up and compared with the life-history of each of a pair of non-identical twins, when one twin of each pair has suffered from schizophrenia or has developed homosexual traits, have given the following overall results.

In schizophrenia, when a large series of identical twins, one of whom developed schizophrenia, were followed up, it was found that in over 80% the other twin also developed the illness (Kallmann, 1950), and this happened even when both twins had been separated from birth, as, for example, by adoption following the separation of the original parents. In non-identical

twins the concordance rate—that is, the percentage of times when both twins developed the illness rather than when one twin alone developed it—was no more than 15% ; about the average expectation for siblings of a schizophrenic.

A similarly significant difference in the concordance rate between identical and non-identical twins has been found in homosexuality. In identical twins, where one twin develops homosexual behaviour the other twin has been found to develop it in 75% of all cases ; whereas the concordance rate in non-identical twins is about 5% —no higher than that estimated as the overall incidence of homosexual tendencies in the population as a whole (Kallmann, 1952).

The lesson to be drawn from these two examples of the value of twin studies in psychiatric research is that in each case the constitutional factor must be of very considerable importance. This in turn means that some structural or inherent and dynamic pattern of response must be handed on from one generation to the next, and must distinguish the individual who develops either schizophrenia or homosexuality from most of the individuals who do not. Our research into schizophrenia, which is now becoming increasingly geared to the concept of a physiological basis, therefore receives endorsement in this direction from the type of genetic study which I have just outlined.

Psychosomatic Approach

The impact of physical or emotional stress and its effect upon bodily and mental equilibrium is traditionally a major concern of all medical and surgical research. What has been called the psychosomatic approach to medicine and surgery, still relatively in its infancy, immensely potentially productive of knowledge and understanding, has taught us that there is probably a single fundamental aspect of the response of all living creatures to everything they have to endure, whether it be fear or pain, hunger or infection, emotional stress or physical disease. As doctors we have long known that sudden shock can produce sudden and sometimes catastrophic physical and mental responses. We have begun now to see that, in a comparable way, the long-continued battle with stress and tension which it is the lot of so many of us to fight is not a battle in which it is always very profitable to distinguish between hard knocks and hard feelings ; nor are the scars borne separately upon the body or upon the mind. They have their being, like those who bear them, somewhere in the tangled, intricate, and mysterious unity already referred to as man himself.

The group of illnesses which lend themselves particularly to psychosomatic study embrace not only primarily psychiatric disorders but all those illnesses in which emotional factors may play not simply a significant, but sometimes a decisive part in regulating the course and outcome of the disorder. Such conditions include ulcers of the stomach and duodenum, various forms of colitis, many cases of high blood-pressure, and some forms of heart disease such as angina, as well as such apparently diverse ailments as certain skin diseases, allergic complaints like asthma and hay-fever, and also migraine, rheumatoid arthritis, and on occasion diabetes mellitus. On the physical plane the diversity of these illnesses is by no means as great as it may seem. Both angina and migraine, for example, depend for their appearance upon alterations

in blood-flow through the arteries supplying respectively the heart and certain parts of the brain and its covering. Moreover, all these complaints have in common the importance of the contribution of the autonomic nervous system in their development. The factor which they share that from our point of view is the most striking, and incidentally the most recently established, is the large part that continued emotional stress appears to play in producing and maintaining them. The example of diabetes mellitus, because less well known, is worth elaborating briefly.

Example of Diabetes

When I was a medical student we were rightly taught that the failure of normal uptake of sugar from the blood-stream into the liver, muscles, and other organs where it could be employed as a fuel, which is a salient feature of diabetes, was due in turn to a failure of secretion of insulin from the pancreas. It followed from the work of Banting and Best (Banting, Best, and Macleod, 1922) that one of the important ways in which diabetes can be controlled, though it can never be entirely cured or reversed, is by the administration of insulin, obtained from suitable animals, to the patient. The calculation of the quantity of insulin required for each patient to balance his output in energy and his intake in sugar remains a matter for skilled and careful initial determination and subsequent regulation and supervision.

Twenty-five years ago, we knew that certain disasters could change the insulin tolerance and therefore the entire equilibrium of the diabetic patient. Chief among these were infection, and the physiological shock associated with injury or even with operation under anaesthesia. The contribution of the psychosomatic approach to medicine has since taught us that another and powerfully significant factor can be emotional disaster.

Sudden bereavement, the infidelity of a husband or wife, or even the collapse of a business or the loss of a fortune, can precipitate diabetic coma in a previously stabilized diabetic in precisely the same kind of way as infection or physiological disturbance. Blood-sugar levels and insulin tolerance would appear to be as intimately related to states of mind as to any other changes in the overall environment of the individual.

Reaction to External Experience

This is only a particular instance of the way in which the normal stresses of anxiety or grief inevitably affect the biochemical equilibrium of the individual, and through this may further change that individual's capacity to interpret and react to external experience. A hypothesis developed from this clinical observation was included in a contribution to the symposium on schizophrenia (Stafford-Clark, 1957). In briefest outline the theory is this.

The normal response of an individual to any frightening or threatening situation includes the subjective feeling of anxiety or fear as one of its components. Another component is the increased concentration of adrenaline in the circulating blood, and ultimately in the brain itself (Weil-Malherbe, 1955). This has been shown experimentally to affect the overall pattern of electrocortical activity in the brain, possibly by interference with synaptic transmission between cortical neurones (Marrazzi and Ross Hart, 1955). It is a reasonable hypothesis that the effect of adrenaline upon electrocortical activity within the brain and nervous system may well account for the tendency in anxious and apprehensive subjects to misinterpret or mis-identify to a

marginal degree their external experience. The frightened sentry, crouching alone in his foxhole, tends in his accumulated fear and tension to mistake a tree for an approaching enemy, a creaking bough for the sound of a crawling man. He may let fly at a hare scampering across his horizon, convinced that this is the first member of an enemy raiding-party. Such misinterpretation, amounting to a transitory illusion, may in fact be caused by nothing more toxic or abnormal than a high adrenaline concentration. Moreover, in the practical experience of the soldier on active service, this kind of thing is only too well known, and its recognition may even influence a commander's choice in distributing dangerous duties among relatively inexperienced soldiers.

The next stage towards a truly pathological condition may be postulated as the addition of a factor of exhaustion, caused, for example, by protracted loss of sleep, wherein actual hallucinations and disorder of thinking may be seen as symptoms; as exemplified by observations of volunteers who have taken part in sleep-deprivation experiments and subsequent tests. One stage further on, true toxic confusional states, and episodes of delirium, show us how exhaustion plus circulating toxins or metabolic errors can produce profound states of mixed psychotic and dementing symptoms, characterized by a gross interference with the patient's interpretation of his external world. Such reactions differ only in their duration from what has been defined as true madness.

It has already been suggested that we can bridge the gap between the loss, impairment, or distortion of contact with reality seen in toxic confusional states and our knowledge of true madness in the form, for example, of schizophrenia, by a study of what have been called model psychoses (Hoffer *et al.*, 1954); disturbances of contact with reality which can be precipitated by a number of drugs such as cannabis indica, adrenochrome, and lysergic acid. These drugs undoubtedly act upon the biochemical equilibrium of the brain, and therefore ultimately upon the patterns of electrical conductivity which it displays. Research along these lines has suggested that could we but discover the exact biochemical disturbance which underlies various forms of mental illness we might be able to prepare substances which could block either the formation of these abnormal biochemical constituents or their disruptive effects upon normal cortical enzyme activity, even in established schizophrenia, and thereby restore the patient to normal health.

Emotional Stress

There is another way in which we may yet be able to fling a bridge across the gap separating our knowledge of the reversible states of delirium from our tentative explorations in the nature of insanity. This forms the basis of a project which I and a number of colleagues have proposed launching in the field of active clinical research, and which I will briefly describe.

There are already patients who become disturbed or confused in their contact with and appreciation of external reality, in the absence of actual infectious or toxic delirium. These people break down into states of profound emotional and intellectual disturbance in response to environmental threats or challenges, or the stresses of serious illness of a more chronic kind: The women who exhibit forms of insanity after childbirth, the patients who become bewildered, deluded, or psychotically depressed after the diagnosis, or even the successful treatment, of serious illnesses, such as cancer,

or congenital heart disease. Such patients may not display obvious clinical evidence of acute biochemical disturbance: their illness may be both more subtle and more prolonged: and yet with it may go a disturbance of their mental health which may last weeks or sometimes even months, being exceptionally suitable for study in an in-patient psychiatric unit completely integrated with the medical and surgical practice of a general teaching hospital, and such as we have at Guy's.

Some Brief Clinical Examples

Case 1.—A 35-year-old childless housewife with severe mitral stenosis was undergoing preliminary investigation for assessment for mitral valvotomy. While in hospital she became increasingly alarmed and began to develop delusional ideas; for example, that her heart had been punctured during the course of cardiac catheterization and was collapsing like a shrivelled balloon; and that it was no longer safe for her to eat anything because her intestines had become a series of gutters in danger of overflowing their contents, which would then accumulate and putrefy in the bottom of her pelvis. The basic psychiatric syndrome appeared to be a schizophrenic episode with somatic delusions released by the stress and fear of the approaching ordeal. Appropriate treatment succeeded in restoring completely her morale and mental and emotional clarity. She lost her delusional symptoms, and after four months was considered fit to undergo the operation, which in fact proved successful.

Case 2.—A young woman of 19 had atrial septal defect for which surgical repair had been considered possible. Shortly after admission she developed symptoms of marked emotional disturbance, wandering about the ward trailing her nightgown and scattering torn scraps of scribbled messages of an incoherent kind. Her behaviour resembled that of an imaginative schoolgirl acting the part of Ophelia. The basis of this reaction appeared to be a subjective conviction that she could not hope to survive an operation upon an organ as vital as the heart, whose disability had caused her relatively complete invalidism throughout her entire life. With the emergence of her fears and her increased capacity to communicate her feelings about them she lost her conviction of impending death and gradually settled down. Nevertheless it took this extremely vulnerable and immature young woman five months to be fit for operation, which ultimately was also successfully completed.

Case 3.—A spinster of 48 who had nursed her invalid mother for many years prior to the latter's death from carcinoma of the breast, herself developed a lump in the breast which for some time she feared to reveal to her doctor. Having ultimately undergone biopsy at another hospital, she was informed that a second operation would be necessary and would take the form of "a deeper cut." On recovery from the anaesthetic on the second occasion she discovered that she had undergone a radical mastectomy and became increasingly depressed, paranoid, and deluded, convinced that her "inside had been removed, womanhood taken away, no longer all a person, converted into a living corpse. . . ." She was transferred to an in-patient psychiatric unit, where a diagnosis of severe depressive reaction with secondary paranoid features and hysterical overlay was made. She remained psychotic for two months, but ultimately recovered, though still attending for follow-up and support.

It is of course perfectly clear that the factor of emotional stress is of profound importance in cases of this kind. Nevertheless, when their response to such stress assumes a form both unquestionably psychotic on the one hand, but relatively rapidly reversible with appropriate treatment on the other, it presents us with a unique opportunity for studying all aspects of the psychophysiological disequilibrium which has occurred.

It may be that if we could determine the biochemical baseline of function of such patients during the stage of

their illness in which symptoms of mental disturbance declare themselves, and also after recovery, we might be able to discover what are the key changes in metabolism of the brain and nervous system which actually give rise to the symptoms of mental illness displayed. A connexion has already been demonstrated between certain forms of disordered biochemical function in the liver and symptoms of mental illness of a relatively specific kind (Sherlock, 1958).

A survey of all the clinical material passing through a teaching hospital and a group of associated hospitals, correlated with psychiatric studies of the patients so observed and whatever biochemical correlation can be worked out with the nature and duration of their symptoms, may yet take us a step further along the road to discovery of the true nature of mental illness.

The Brain an Electronic Computer

But it is perhaps in the study of man's conscious and unconscious reaction with his environment in its widest sense that the method of psychological inquiry has still its greatest single contribution to make. Man has been called a communicating animal; and certainly he conveys and experiences his loves and hates, his hopes and fears, his values and principles, and the greatest discoveries of his mind, through a communications system which is the most complicated and yet most flexible known to exist. The mathematical theory of communications, which can be related to psychological methods of inquiry and concentrated in the dedicated study of man's mind by man himself, may provide ultimately one of the keys by which all our interlocking processes of human existence, and particularly of practical psychiatric knowledge, can be opened for our fuller understanding.

There is a good deal to be said for using the working analogy of an electronic computer to convey something of the way in which the brain works in this sense. But the brain is an electronic computer with fifteen thousand million separate cells, of possibly immeasurable complexity, which provides for its remarkable flexibility and wonderful precision. We have already seen that the electroencephalogram, crude though its information must yet remain, at least supports the view that it is in its electrical function that we must seek the practical key to the work of the brain. Its communication is by electrical signals, and their transmission from neurone to neurone through synapses is probably the way in which patterns of activity are regulated and controlled. It has indeed proved possible to use the mathematical theory of communications to draw some tentative conclusions about this aspect of the work of the brain (Ashby, 1952).

But all models which have so far been constructed to give working analogies of brain function have taken the source of their electrical power for granted. Such power has in fact been piped in from the local main supply in the laboratory, or stored in accumulators hitched on to the working model. I am sure that in all our research we must never forget that the brain is the only electronic computer which manufactures its own electricity biochemically as it goes along. In studying the functions of the brain, therefore, we have to remember that we are at least two removes from the subjective experiences, and from the output in terms of behaviour, which we seek to explain. At one remove there is the electrical network, in all its wonderful complexity and beautiful

intricacy; and at the second remove there is the biochemical process, also wonderfully intricate and many-sided, whereby the brain continues to live, to breathe, to gain its nourishment, and to make its power. It is in the biochemical aspects of brain function in health and illness that we see those changes which may affect both conductivity and availability of electrical power within the system. And it is the ultimate translation of this power into electrical signals, which are themselves the only measurable accompaniment to thought and feeling, which presumably alone makes these processes possible.

Our relative technical proficiency in measuring biochemical changes must never blind us to the fact that these are of ultimate importance only in their effect upon the patterns of electrical activity, conduction, communication, and control in the final functioning of the brain; and as clinicians we must never forget that communication remains the ultimate key to the treatment of schizophrenia, or indeed of any other kind of illness. In one sense the cardinal features of schizophrenia may perhaps be regarded as respectively: (1) A failure to make the usual interpretation of external or internal events; for example, to understand what is going on in the world outside, or indeed what might be going on in one's own body. (2) A failure to communicate in the usual way with other people. (3) A failure to integrate interpretation and communication, within one's self or with others, in a way which will allow even the first two difficulties to become apparent in their full nature to any but the trained observer.

There is, in fact, so far as brain function is concerned, a failure of communication and control. Clinically it is this failure of communication and control which brings the schizophrenic to the doctor. However skilful and appropriate our physical treatment of schizophrenia may become as the result of refinement in our knowledge and understanding, both of the biochemical processes which may underlie it and the electrophysiological processes whose secondary disturbance ultimately brings about the illness, it remains true that we can treat patients successfully, and restore them to true health and happiness, only if we gain contact with them at a human and personal level, and give them thereby the bridge over which they may cross back to normal harmony and understanding with their fellows. This is the ultimate aim in every aspect of clinical research in psychiatry; and indeed it is the ultimate aim of all forms of research directed towards the understanding or relief of mental illness.

Conclusion

In this address I have had time only to touch upon the fringes of the possibilities of research in psychiatry: the tripod of inquiry based respectively upon constitutional studies, physiological and biochemical investigations, and the study and practice of communication between human beings and the groups. If, as we believe, the possibilities are so immense, and our equipment for dealing with them in terms of both knowledge and technique constantly increasing, what is it that holds us up? The basic answer to this question is brutally simple: time and money.

It takes years of training to produce people capable of the type of basic or clinical research required in this field. These people have got to live, and they have got to have reasonable inducements to spend the time

planning and formulating the possibilities of research, and observing the material from which their hypothesis can be constructed, before any of the ambitious programmes of which they may be capable can even be begun. In this respect time and money are almost interchangeable terms. Even the preparation of this lecture, and the selection and review of the points by which I might hope to bring home the challenge and the possibilities throughout the whole field, has necessarily employed time for which many other activities have been competing. Unless one has research teams suitably recruited from able physicians and laboratory technicians, and amply supported by the necessary funds, the ideas which are needed to follow up possibilities will not be thrown up, the hypotheses will not be formulated, and the work will never be done. In this respect it is interesting to compare the way in which the design of our bodies makes allowance for the service of our brains with the way in which research into the activities of the brain is provided for in modern society.

The human brain is an organ weighing between forty and fifty ounces, roughly one-fortieth of the total body weight. Yet it receives no less than 25% of the total blood supply circulating through the body, and it receives it first: immediately after its oxygenation and refreshment in the lungs, and before its distribution elsewhere. If we compare this distribution with the distribution of money by the community for the care and study of mental illness as a fraction of the total sum spent upon the care of all illness, the comparison is striking. The average expenditure on medical care of patients in the mental hospitals of this country is in the region of five shillings per week per patient (Robinson, 1958). Comparable figures for the overall cost of medical care for patients in general hospitals (and the teaching hospitals are specifically excluded from this comparison owing to their disproportionately but necessarily high cost of operation), are twenty-five to sixty shillings a week.

Therefore, while the organization of the human body allocates to the maintenance of the brain roughly twelve times the proportion by weight of all its most vital resources in comparison to those given to the rest of the body, the distribution of money in the community in which we live almost exactly reverses these proportions. Expenditure upon the care of bodily ailments, other than those affecting the brain, exceeds by twelve to twenty times that provided for medical care, treatment, and research into mental illness. And this is all the more incongruous, even from the purely economical aspect, when one realizes that at the present time 40% of all the beds in the National Health Service are occupied by patients suffering from mental illness.

One of the objects of this address has been to outline some of the tools and methods of modern research in psychiatry, which in the last twenty-five years have increased immeasurably the possibilities for progress. If we add to these tools and methods the natural skills and interest of those already active in the field, and recognize that almost the only significant limiting factors upon our progress are those of time and money, then we reach the point at which the implications become inescapable.

Money must be made available to those with the initiative, interest, resource, and responsibility to use it; and made available even in advance of specifically endorsed projects with a predictably favourable

outcome. If enough able and imaginative people are to be sustained in their willingness to commit themselves to the uncertainties of research, somebody must be prepared to gamble something on them: otherwise the projects of which they are potentially capable may never be conceived, or may remain crippled in their execution by lack of funds—at least in this country.

This, then, is the challenge which faces us. But if we retain the wit to see that the exploration of man's mind and its psychophysiological foundation in his brain is at least as significant an activity as the exploration of that extension of its environment which we call outer space, and so devote to clinical research in psychiatry even a fraction of the expenditure already laid down for cosmic rocketry, we need not fail.

REFERENCES

- Ashby, W. R. (1952). *Design for a Brain*. Chapman and Hall, London.
 Banting, F. G., Best, C. H., and Macleod, J. J. R. (1922). *Amer. J. Physiol.*, **59**, 479.
 Hill, D., and Watterson, D. (1942). *J. Neurol. Psychiat.*, **5**, 47.
 Hoffer, A., Osmond, H., and Smythies, J. (1954). *J. ment. Sci.*, **100**, 29.
 Kallmann, F. J. (1950). *Congr. int. Psychiat., Paris, 1950*, vol. 6; [Genétique et Eugénique] **1**, 31, 35.
 — (1952). *J. nerv. ment. Dis.*, **115**, 283.
 Marrazzi, A. S., and Hart, E. R. (1955). *Science*, **121**, 365.
 Robinson, K. (1958). *Policy for Mental Health*. Fabian Res. Ser. No. 200.
 Sherlock, S. (1958). *Diseases of the Liver and Biliary System*, 2nd ed., p. 88 Blackwell, Oxford.
 Stafford-Clark, D. (1957). In *Schizophrenia: Somatic Aspects* (edited by D. Richter), p. 173. Pergamon Press, London.
 — Pond, D., and Lovett Doust, J. (1951). *Brit. J. Delinq.*, **2**, 117.
 — and Taylor, F. H. (1949). *J. Neurol. Psychiat.*, **12**, 325.
 Weil-Malherbe, H. (1955). *J. ment. Sci.*, **101**, 733.
 Williams, D. (1941). *J. Neurol. Psychiat.*, **4**, 257.

FOLLOW-UP STUDY OF ARTERIAL PRESSURE IN THE POPULATION OF A WELSH MINING VALLEY

BY

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During three months of the winter of 1953–4 arterial blood-pressure measurements were made in a random sample of the general population of the Rhondda Fach, one of the Welsh coal-mining valleys (Miall and Oldham, 1955). Subsequently a similar survey was carried out in the agricultural population of the Vale of Glamorgan (Miall and Oldham, 1958). Both surveys were designed to give measurements which would form the basis for longitudinal studies.

Four years after the first survey in the Rhondda Fach, during the same three months of the winter of 1957–8, measurements were repeated under exactly comparable conditions for the survivors of the original population. The findings confirmed the influence of parity and occupation on arterial pressure found previously, and a fuller analysis of the results will be published when the first follow-up survey of the agricultural population has been carried out. In this paper other findings from this first follow-up study are presented and discussed in relation to changes in cardiovascular mortality reported in the most recent publications of the Registrar-General.