Research and understanding*

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WITHOUT the research that promotes reappraisal of knowledge and the creation of new knowledge there can be no progress in medicine. Medicine flourished for centuries in the midst of empirical guesswork and ecclesiastically regulated tenets of belief. Nevertheless, with astute perceptive minds, medical men have often played an important role in the observations of natural events which contributed to the spawning of modern sciences. Gilbert, who studied magnetism, Linnaeus the botanist, and Helmholtz the physicist, were all doctors. Johann Gottlob Krüger, a professor of medicine in Helmstädt, published a book on electricity in 1745. His friends asked him why he was interested, and he answered, 'God only knows what the wise heads of the future will make of it all. It certainly has no application either in theology or jurisprudence so where else can its use be but in medicine?' How right he was, for the application of the physical and chemical sciences and the technology of modern electronics have transformed modern medicine and the biological sciences on which medicine is based.

Indeed, the beginning of research is curiosity, with an ensuing attempt to find an answer to unknown factors or inexplicable phenomena. Techniques of study continue to be refined and elaborated, extending our powers of perception far beyond the phenomena observed with the unaided senses and leading to radical changes in our concepts. As our knowledge enlarges, problems are clarified and illuminated but new areas for further research are continuously revealed. The growing circle of light illuminates an ever increasing sphere of darkness. New opportunities for research are continuously with us, but new approaches require both extensive theoretical knowledge and familiarity with practical technical possibilities, and proposed new studies may indeed be appraised only by a mere handful of gifted specialized scientists.

As scientific method becomes more sophisticated, its language becomes more difficult to translate into non-technical terms. The public, and even government, usually lacking appreciation of the objectives of the scientists, become both impatient for 'results' and resentful about costs. The undercurrent of 'anti-science' becomes more vocal.

In medicine, all innovators have had to face their opponents and detractors. Semmelweis, Pasteur and

Lister, all had opposition from their colleagues in their early and successful probings towards the control of bacterial transmission of disease. The first opposition was within the medical profession. Sometimes the opposition was from ignorance, but often from those with a vested interest in the continued application of earlier methods which yielded lucrative practices. The smallpox inoculators opposed the greater safety of the cowpox method of vaccination introduced by Jenner. His method was ridiculed as being bestial in origin, and personal professional antagonisms exacerbated the disputes. Where doubt and disputation persisted within the profession, the public, shrinking from even the slight discomfort of vaccination, rationalized its fear of needles and lancets by joining the chorus against vaccination on religious grounds, saying that it interfered with the will of God, and on political grounds, that compulsory vaccination interfered with individual liberty.

Even at therapeutic level Sir Victor Horsley's first removal of a tumour pressing on the spinal cord was described by his professional colleagues as an outrage. Horsley had gone too far, and had encroached on the sacrosanct spinal canal.

These are not unique examples, but rather they form a consistent and repeated pattern of reaction to progress throughout medical history. The current trend is basically the same today as in previous generations, exaggerated by the fact that science has become more costly, more esoteric, and its sophisticated equipment has made appreciation of its methods and new discoveries less easy to translate to the public. Scientists have had enormous grants, are often more highly paid, they travel more, and they may be jealously watched from the humanities side of the universities. In medicine there is often reluctance of appreciation by practitioners remote from scientific laboratory contacts. The skilled clinical specialist is described as an 'arrogant technocrat'.

Criticism of the scientific establishment is part of the larger rejection of authority, so fashionable today at all levels of our society. Following historical patterns, sub-groups develop within the profession detracting from the achievements of applied medical science, misinterpreting its purposes, engaging in distortion of its skilled technical refinements in terms imputing a callousness which is completely foreign to the investigating doctor, whose intimate concern is to understand and safeguard by his investigative expertise the well-being of the patients under his care. The mass media concerned with sensationalism

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whip up anxiety and spread public alarm on 'Doctors' dilemmas', often presenting in an unbalanced way, with exaggerations and over-simplifications, matters which can only be finally resolved at the highest levels of specialized knowledge. The recent inept and cruel publicity on the Issels cancer clinic shocked us all. There is also a lack of appreciation of the great progress which has accrued to human advantage from the development of new methods of study and resulting modification of management of individual distressing illnesses. The abolition of poliomyelitis, to take one example, resulted finally from human experiment carried out with deep scientific conviction and concern for humanity, as was Edward Jenner's first vaccination of the boy Edward Phipps in 1797.

Public anxiety about science is not, of course, confined to medicine, although medical research may affect them personally, intimately, and directly. It spreads to other fields on the biological consequences of the use of insecticides and weed killers and the immense overriding fear of atomic warfare. The public may demand, and indeed will demand, more research directed towards cures of the ills of mankind. A cure for cancer or for rheumatoid arthritis may be regarded as a necessary objective, but necessity is not automatically the mother of invention. The possibilities in these fields can only be appreciated and can only be judged by the scientists themselves who are closest to the subject, and trained in the necessary techniques of study of the multitude of facets of these outstanding human and biological problems. Decisions on possibilities must still be delegated to the experts, and there is no escape from this manner of working. Politicians would love to decide, but warnings by the scientific world have been little heeded that implementation of the Rothschild recommendations is only likely to lead to much misdirected effort and waste of resources on ill-defined problems.

'To suggest that the active curiosity of original minds should be turned to topics selected by lay arbiters, is a regimentation which will frustrate its own ends. Problems of the day are too crowded with shifting and arbitrary variables for the gifted research worker' (Masson, 1940). The results achieved by the individual research worker may appear to deal with minutiae and may appear useless to the public. The integrated effects of them will reach public appreciation only after a long time when the results will finally be used by society to its advantage. Nobody could ever have ordered the research that would make the body transparent, but if this had indeed been commissioned the result would have been 'teams of research workers, a waste of money, and no X-rays. Roentgen had no team and no plan' (Baker, 1942). Indeed he worked only on electrical discharges in a

vacuum tube and hit on the discovery of X-rays the course of this work. Call it 'scientific roulette' if you like.

Opinions are even expressed, and sometimes by people who ought to know better, that we have already amassed a sufficient volume of knowledge; that its application would sustain progress for another decade or two. An International Congress of medicine was held in London in 1881 under the presidency of Sir James Paget, who devoted part of his presidential address to combating the idea that research could stop. 'A fallacy to which we are all too prone is to think that we have at length reached an elevated sure position on which we may rest and only think and guide. This attitude has hindered the progress of science.' It is of interest that it was at that same meeting that Koch demonstrated (in the physiology department at King's College, London) his method of separating out different bacteria by the distinctive characters of their colonies growing on gelatine plates. And it was only 5 years later that the same Koch demonstrated the tubercle bacillus. Up to this time tuberculosis was ascribed to the vapours of the night air or other imaginary influences. It was only because research did not stop in 1881 that we have arrived at the conquest of most bacterial diseases today. Think of the money which could have been wasted on the effect of the weather on what proved to be a bacterial disease. There are, of course, still 'old wives' tales about the effect of the weather on rheumatoid arthritis, and if sufficient public money were offered for research on this subject, cohorts of second-rate intellects could be recruited, and finding no end-point to such an impossibly ill-defined investigation, the research could be interminable, correspondingly costly and probably quite unintentionally confounding. Diversion from the study of coronary thrombosis to the rainfall might also belong in this category. I prefer the direct approach by observation and experiment.

One of the great triumphs of epidemiological observation was the recognition that nearly 100% of cases of cancer of the bronchus occur in cigarette smokers. Lord Hailsham once remarked that it was curious that far more alarm seemed to exist about *hypothetical* fears of the use of pesticides and weed killers, and their concentration in the food cycles of animals and birds ultimately affecting human beings, but when the public were repeatedly informed that in this country 30,000 men a year die from cigarette smoking, nobody seemed to care! In America DDT has been used in massive and intemperate quantities mainly to deal with Dutch Elm disease, and DDT has now been virtually banned. Elsewhere in the world, DDT could hardly achieve any damaging level to human beings for many decades. It is only *intemperate* use of this valuable weapon against the

insect vectors of disease and agricultural pests that could conceivably do harm. If DDT ceased to be available in the tropics, millions more deaths from malaria would occur. Fears of evil consequences should be better substantiated before such massive benefits are discarded. Panic reactions ill become bodies responsible for advice to governments. If DDT ever poses a more alarming direct threat to man the solution will be found by scientists—whom else?

It is a curious reflection that the current anti-science climate seems to have dissipated memory of the great advantages accruing from scientific medicine. Disappearance of death from diphtheria, of crippling by poliomyelitis and the elimination of tuberculosis are all taken for granted. With these great achievements behind us there may be some truth that success has made further research less urgent in the public mind. 'The devil was sick, the devil a monk would be; the devil was well, the devil a monk was he.' Health banishes gratitude.

The public must be taught to appreciate that spectacular changes only take place after long creative efforts building the foundations of knowledge. Faith in the continuation of science must be restored. In our own professional setting this means confidence and trust in the doctor and respect for the great leaders of a humane profession who have a dominating interest in finding out how to ameliorate human illness and distress.

Communication

The scientist, like the artist, only completes his efforts when he has an exhibition at a learned society or in print, and like the artist he values appreciation of his work. Communication is all-important, because knowledge must be made available for public use. The days when new discoveries were presented at annual meetings of the British Association have gone. Perhaps one of the last was Haworth's demonstration of the chemical structure of vitamin C at the Aberdeen meeting of 1932.

Communication must take place at at least three levels: firstly, to a small handful of experts within the discipline or its specialized subdivision; secondly, to professional colleagues in the general field or in other allied specialities to whom the new knowledge is relevant; thirdly, to the public, our patrons, who must also be informed at least of the significance of what the scientist is attempting to do, and the progress he is likely to be making.

It is at the first level that precision of detail and critical consideration of the methods in use must be scrutinized. The scientist in isolation is in danger of development of fixed ideas, and without the environment of informed colleagues in a wider range of scientific disciplines he may fall into error. The

language of scientific communication at this level is apt to be bewildering, sometimes even to other scientists in the same general field. If error is made, it must be recognized and corrected publicly, and criticism of scientific claims by peers must be faced without fear and without taking offence. Non-conformity with current authoritarian views must also be given consideration in the light of confirmed new observations.

Once the work has become an acceptable contribution, adding to or modifying previously held views in the general subject, the matter must now be put before a wider scientific audience or to the technologists in industry, or the practitioners of medicine in the relevant field. Getting the ideas across at this level requires skill in presentation and teaching, capacity to rouse interest and sometimes to transfer some degree of excitement about the possible consequences of the new idea. This is the level at which successful communication should not be made difficult or even completely frustrated by less comprehensible technological detail from which the new idea has emerged. I well remember the excitement, indeed the feeling of a new revelation, at a meeting of the Physiological Society in Hampstead, when the late Sir Henry Dale first integrated so simply and clearly with his formidable and charming gifts of exposition, his synthesis of growing evidence on neuro-humoral transmission in the autonomic nervous system. A new world of thought was exposed and clarified, giving new approaches to a whole field of physiological thinking from which fruits are continuously being garnered today. Indeed, the ideas are now being applied to the functioning of the brain itself.

We now come to presentation to the public. Semi-popular scientific journals are now available, but perhaps the greatest instrument of communication can be television. This is already used in the public television network by the open University, and indeed at what we might call the second level of communication, in this and other universities which are making excellent use of audio-visual aids, now a major method of exposition in this series of lectures. The wonderful gifts of teaching by Sir George Porter in his Royal Institution Christmas lectures are memorable, and not only to children.

The scientist presenting his material at *any* of these levels is always the better for a rehearsal. A limited audience of colleagues can point out the defects and difficulties of communication intended for high level or specialist scientific appreciation. This is of the greatest importance, and failure to take this trouble may result in the author of a communication simply giving his paper like a soliloquy, completely out of touch with his assembled audience, bewildered by the complexity of the speaker's thinking. Failure to adapt their communications to the audiences they

are addressing is the greatest defect of our academic intelligentsia. With any student unrest, which has resulted from this criticism of our university teachers, I have the greatest sympathy.

Research should always be linked to teaching. Teaching is a tremendous stimulus to clarity of thought, and the great physicist J. J. Thompson considered that that compulsion to argue from a variety of viewpoints forced on the teacher when making his explanation clear even to a stupid student often compels rethinking and reconsideration of the teacher's own ideas. Indeed, such exercises could convince the researcher that he should have another look at his experimental evidence, as his interpretations might still require further reconsideration. Many of us have had such experiences.

When the research worker is isolated in an 'ivory tower', he may have no need to explain. The MRC's policy of supporting special units in universities is to be highly commended. Separate institutes of research promoted in Germany after Ehrlich have their hazards. They were responsible for a spurt in German science, but they also contributed to the decline of German universities, and with them German science, by withdrawing brilliant researchers from contact with students. Special institutes should be big enough to ensure concentration of appropriate talent on a wide front, but they should be linked by some means to the university system. After all, the student of today must be the research worker of tomorrow; teaching without the critical insight created by research becomes stereotyped and authoritarian.

The social responsibility of medicine

Medical students are anxious to get to work in the poverty-stricken parts of American cities from the very beginning of their training. The development of a social conscience is no bad thing, and it is accompanied by a demand that all teaching should be relevant to the problems which they will face. Even a former president of our Royal College of Physicians criticized the academic university departments because they had not concentrated in seeking cures for disease. This is not the primary task of such units. The exploitation of ideas generated in academic medical departments is more effectively done with the resources of the pharmaceutical industry. Even the discovery of a cure is not the end of research, but rather its beginning. It took 30 years from the recognition in a medical school that a diet of liver could cure pernicious anaemia to the discovery of vitamin B₁₂ in a quantity of a few milligrams, first extracted in Glaxo's laboratories by Lester Smith from nearly a ton of ox liver. The continuation of this research in the universities and in industry has not only added to our understanding of the control of blood formation,

but has had extensions into many other fields related to the control of cell metabolism.

The academic clinical departments have indeed made great contributions to the understanding of the disorders to which flesh is heir, and they have set standards of critical thinking and analyses on clinical situations not achieved by any previous medical educational system. If current trends of interest in wider aspects of community and family medicine should dilute the teaching of scientific medicine to the medical student, whose time in a university atmosphere may indeed be limited to his few student years, the net result could be a serious retrogression in the status of our profession and in the standard of our work. The 'soft' sciences of sociology should supplement, and not replace, the training of the doctor in the critical thinking he must apply to the care of his patients. After the last war the socially minded physicians were pressing for more sanatoria for the tuberculous. In medical schools the ingenuity of scientists was quietly developing streptomycin, which at one stroke practically eliminated this major cause of death and misery, as well as saving an enormous financial outlay.

Let us in the midst of these disputations recognize at once that the standard of medical care in this country is higher than anywhere else in the world. In our hospitals—and all are now involved to some extent in teaching—exhibition of work to students and trainees calls for exemplary standards. Much of the profit motive of medical care has been eliminated, and judgements on patient management are, therefore, less biased by personal advantage and more objective than in many other parts of the world. Nevertheless, the necessary partnership between general practitioner and specialist shows signs of uneasiness in the overlapping margins. But the partnership between specialist and general practitioner leads to a balance of mutual help and judgement to the advantage of the sick man. The general practitioner sometimes claims a monopoly of kindness and loving care. This indeed we may also receive from our families and friends in illness, but ultimately technical knowledge is required to decide what to do. It is all very well to say that most illnesses, most symptoms, are imaginary, but we shall all die sooner or later and we do not die of imaginary disease. Deep knowledge is required in the management of afflicted humanity, and progress depends on specialized study. It is our inescapable primary responsibility to understand disease.

Medical research must continue. The appreciation of research by society undergoes change from time to time. Different public attitudes are adopted in peace and in war. In the last war a large corps of volunteers in the Friends Ambulance Unit, and indeed many of the public, offered themselves for a

variety of technical studies, where these were regarded as of potential value in the saving of life in the armed forces. The wish to benefit others is still apparent, uniquely in our society, in our voluntary blood transfusion donor system. Now the restrictions on inviting co-operation of volunteers in medical studies are considerable, and various devices including ethical committees have to be set up in every hospital so that any investigation can receive approval before it is carried out. Even the most harmless comparison of the natural course of illness with a new treatment involves deceiving half the patients. The so-called double blind trial is not a good method for solving the problems of marginal advantage from a system of treatment, especially in chronic disease. Anti-coagulants were considered to have prophylactic effects following coronary thrombosis; but over 20 years of such trials and expenditure of as many millions leave us with a negative answer.

The volunteer must be given the fullest explanation of every possible risk which could ensue from the clinical trial. A professor of clinical pharmacology (U.S.A.) said to a patient 'I wish to give you a drug, and observe its effects, and I must explain to you the risks.' 'Yes, doctor.' 'It has been known to produce a severe form of anaemia, and also cause gastrointestinal bleeding from ulceration of the stomach. It can produce asthma if you are in any way inclined to develop this disorder, and sometimes along with asthma it brings on skin eruptions. It may also interfere with the formation of some important elements in your blood, diminishing your leucocytes, and it might even precipitate a bleeding disease. Combined with other substances and taken over a long time it has been recorded as causing damage to the kidneys.' 'Doctor, I do not think I would be willing to take this drug.' Reply: 'The drug I am talking about is aspirin.' 'Oh, doctor, if that's all, certainly. Let me have whatever you like in the way of tablets.'

The idea that a full explanation and complete understanding can be given to every patient who is undergoing diagnostic or investigative tests is completely unrealistic. Some intelligent patients understand a good deal of what they are told, but with the wide scatter of intelligence levels among the general public, many are either bewildered or completely unaware of the meaning of the explanations. The final responsibility for the conduct of any new observation or the use of any new remedy lies with the individual and responsible medical investigator. If medical research is to continue, let us appreciate that it is continuously improving the quality of human life and prospects of survival. Infinitely more lives have been damaged and lost through lack of knowledge, while the damage resulting from medical investigation has been infinitesimally small. The public need repeated reassurances on such points.

When faced, as so many of them are, with severe disabling and crippling diseases, sympathy and pity make it our duty to reach a satisfying solution and, if other circumstances require precision, to continue our studies with modern medical scientific technology, e.g. in deciding the whether or not to resort to cardiac surgery. In this we have the confidence and trust of our patients and this confidence we must never abuse.

Throughout scientific history the research worker has always had difficulties. In recent times he has had to eschew the larger incomes of private practice. When young—and the time of maximum investigative inspiration is before 30—he has had to conduct his efforts in the midst of frustrating uncertainties about his future. There is no career structure for the investigator, and he must hazard his future welfare in his determination to take up research. He is under constant pressure to go out into service work, and indeed, he is offered higher payments if he does so. We must nevertheless sustain, develop and support a cadre of selected highly trained young men, who are fitted to become our teachers and leaders of the future. Their self-sacrificing efforts must be appreciated, because the beneficial consequences of their work will be cumulative. They already face enough obstacles and, if the organization of the health service and re-organization of research makes their course too difficult, there is a danger that we shall not recruit the best, as too great hardship can suppress idealism. Limited 3-year contract research may be useful in testing research potential, but it will not sustain the broad base of experienced research workers who must be in the universities.

The underlying conflict between the pastoral and scientific responsibility of the doctor may be expressed in the words of Elizabeth Wordsworth:

'Yet somehow 'tis seldom or never
The two hit it off as they should,
The good are so harsh to the clever
The clever so rude to the good.'

Without continuous revision of the theory on which our practice is based we should cease to be a profession. Wisdom, unlike intelligence, is not a natural gift, but is proportional to the breadth of knowledge brought to bear on the situation, and this is only achieved by continuous study, research, critical thinking and the hard school of experience.

Finally an exhortation from the Bible (Proverbs iv. 7): 'Wisdom is the principal thing . . . therefore get wisdom. With all thy getting, get understanding.'

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