Medical Research: The Tree and the Fruit.¹

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UP to quite modern days, the physician followed the strict Hippocratic tradition of concentrating his powers upon the welfare of the individual patient. He relied greatly, if not chiefly, upon rest in bed and upon the *vis medicatrix naturae*. He gave drugs for the palliation of symptoms, but had few, if any, weapons for attempting the specific cure of disease. His art, an art highly developed and refined, almost expended itself upon diagnosing accurately the exact process and the end result of the disease. I am not forgetting, of course, the exercise of his skilled functions in the right management of the patient's state of mind and in giving sympathetic and practical help to his friends—functions which in the physician's art at its best have always invested his office with a high nobility. But through the past generation, it has been his medical and non-medical colleagues in the scientific laboratory who have been putting into the physician's hands new weapons of precision, in the forging of which he has played little part himself and the mode of action of which he has to take largely upon trust.

The new sciences of organic chemistry and pharmacology have been yielding many new drugs artificially built up in the laboratory, that have specific and measurable actions upon particular microbes causing disease. Of these, salvarsan may stand as a type. Chemistry and pharmacology together have also given a new meaning to some of the oldest drugs that after immemorial use by native tribes have been prescribed by physicians for many generations. The infusions of the ipecacuanha root have long been used for the treatment of dysentery. Bacteriology has shown that dysentery is of two quite different kinds which earlier medicine had treated as one. One kind is due to infection by a particular group of bacteria; the other kind is due to organisms like the amœbæ belonging to the class of protozoa. Workers in India showed that it was the alkaloidal constituent of ipecacuanha which had this curative action, and later that this constituent, emetine, had its specific action only upon the amœbæ of dysentery and not at all upon the bacterial dysenteries. This specific action has been lately studied by new methods in the National Institute for Medical Research, and the path is open for an advance towards new and still better remedies for amœbic dysentery.

Cinchona bark, again, has been used as a remedy for malaria in Europe for two or three centuries. Of its various alkaloids, quinine was early isolated, and the physician concentrated upon this without any evidence that it was superior in its anti-malarial action to the other alkaloids present in the bark that were thrown away when commercial practice attended only to the quinine. This arbitrary choice of one constituent, although we now

know that other cinchona alkaloids have effective anti-malarial actions, dictated the policy of selecting the species of the cinchona tree which yielded most quinine, irrespective of other important considerations, with the result that the world-price of the remedy practically available in commerce was kept disastrously high. In quite recent years the properties of the other alkaloids have been more thoroughly studied, and now the chemical laboratory has already produced a synthetic compound the action of which approximates to that of cinchona bark and gives hope that an effective and cheap specific may finally take its place.

Besides the specific remedies of this kind now provided as weapons of more precision for the physician, another important group of remedies has come into his hands. These are the so-called hormones—substances naturally produced within the body for the chemical control of particular functions. Knowledge of these is the result of the steady development during a whole generation of this branch of physiology, and British workers have played an active and most distinguished part in it. Some of these hormone bodies, for example, adrenalin, which controls the activity of the muscular coats of the blood vessels, intestines, and other organs supplied by the sympathetic nervous system, have a known chemical composition and can be made artificially. Most of them can only be prepared by extraction from the appropriate organs and have a molecular construction so large that it has not yet been chemically described. One of the most familiar of these, the active principle of the thyroid gland which the physician uses to remedy inborn or accidental deficiency, has lately been isolated and chemically described in London, and to this brilliant achievement, long the ambition of workers in other countries, has been added that of artificially constructing the molecule and so of synthesising the active principle 'thyroxin'.

Much has been heard lately of insulin, now used for the treatment of diabetes. This is a chemical substance of composition still unknown that is naturally produced within the body to control the use and disposition of the sugar-like substances derived from food which, roughly speaking, are concerned in the combustion processes supplying energy. A child or adult with inborn or incidental deficiency of insulin suffers from diabetes. He sinks into ill-health, kept at bay only by rigorous discipline, and he is faced by the prospect of increasing distress and an early death. These sufferers become as by magic normal and healthy persons if insulin is given to them from outside, and they remain normal so long as it is given. Those who would wish to belittle any result derived from animal experiments, even when the result derived is so great a work of mercy as this, are fond of asserting that insulin does not cure the disease. It is true that it does not remove the

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underlying cause of the deficiency, but it makes good the deficiency itself. It brings comfort and normal life to the diabetic sufferer for so long as its supply is maintained, just exactly as food brings comfort and life to a starving man, and for so long as it continues to be given.

It amounts to a truism to say that progress in the practical arts of medicine in any of its branches, whether preventive or curative, only comes from the growth of accurate knowledge as it accumulates in the laboratories and studies of the various sciences. We find it a law of our state of being that, where only observation can be made, the growth of knowledge creeps; where experiment can be made knowledge leaps forward. The observation and description of diseases by physicians over many centuries have led to almost imperceptible advance. The experimental method, only fully and widely applied in the last generation or two, has given more progress in each decade than all earlier recorded history.

Mankind naturally will always be eager for practical progress in medical work. Every layman now knows something of the many recent triumphs in medical science, but he knows also that these are isolated and incomplete. He sees clearly that, rapid as our progress has been within a period of years, amazingly short when compared with the preceding centuries, we are not in sight yet of anything like a victory over disease all along the line. It is a commonplace to complain that a common cold can be neither prevented nor cured. Every human child obtains its first lesson about the state of medicine by discovering that, as each infectious disease comes in its turn, the doctor has no magic beyond that of giving rest and warmth in bed. The general case-mortality rate for grave infections like those of pneumonia or puerperal fever has remained almost stationary for many years. The cause of acute rheumatism in children with its pitiful tale of subsequent heart disease is still unknown to us.

Every schoolboy knows the romance of the discoveries of the causation of malaria and its mode of transmission; he has learned in his geography lesson of the triumphant control of malaria and yellow fever that allowed the construction of the Panama Canal. But even in this region of tropical disease the layman sees that something is wrong and that our present knowledge does not allow us to press forward to final success. Yellow fever is still entrenched in West Africa, where it broods as a continual menace to the rest of the tropical world, its potential dangers being greatly increased by the modern possibilities of rapid transport. As to malaria, we have to admit that there are probably more rather than fewer sufferers in the world as a whole, though more than thirty years have passed since Ross under Manson's direction proved its insect transmission. We know enough to free a limited area from the disease if enough money be spent. Much more knowledge is required before we can hope for wider success in a general campaign. A hundred million sufferers in India alone must

wait for relief until some generations of betterment have been traversed or until some increase in our knowledge brings, as we have every right to hope, some new kind of power.

To rest satisfied with our present achievements would indeed be a counsel of despair, and nothing could be more foolish or inhuman. Though our failures and deficiencies may be great, yet the successes already gained in the last few years, which are but as a brief moment in the history of man, should give us boundless confidence. Only the growth of scientific knowledge can bring success, and every victory must wait, as we know, upon the efforts of the unseen army of scientific workers. Practical statesmanship will turn at once to consider how that army can be aided and how it can be augmented. Let me quote Bacon again from his "Advancement of Learning". Three centuries ago he wrote: "If you will have a Tree bear more fruit than it has used to do, it is not anything that you can do to the boughs, but it is the stirring of the earth and putting new mould about the roots, that must work it". To turn this advice of his into practical effort to-day, we must consider in respect of our scientific army the primary questions of recruitment, of pay and of status, and I will take those points in turn.

As to recruitment, it can only be in the universities that the ablest young brains will be caught for the service. While it is true, indeed because it is true, that as Burke said, "the State is a partnership in all science, a partnership in all art, a partnership in every virtue and in all perfection", that Government will always be wise that makes the universities strong and leaves them free.

If the service of research workers is to be recruited and maintained, questions of pay and status must have paramount importance. So lately as until just before the War, it was the almost universal rule in Great Britain that nobody should be paid for doing research work as such. Unless a man had private means, he could only keep himself at research work by being paid to do something else which very commonly conflicted with it. Much of it has always been done, of course, by university professors and other teachers heavily burdened with routine official duties. Salaries in academic life are in general indefensibly low. Even now professors who may be most eminent men of world-wide reputations, are fortunate if they receive £1200 a year, which was the low normal standard fixed by the recent Royal Commission for Oxford and Cambridge, and only a few with special administrative responsibilities receive £1500. These are salaries which men reaching eminent success in any other walk of life would regard as an offence, and even in the academic world the headmaster of a great public school would think of them derisively. In the junior university posts the salaries are relatively even lower. A man of distinguished ability, whether in teaching or research, may count himself lucky if after an expensive training and years of toil he earns £500 a year before he reaches thirty years of

age. It is true that since the War the nation has greatly increased the resources of the universities by direct grants made through the University Grants Committee, and indirectly by the funds made available for the several departments responsible for promoting research work in the three fields of agriculture, medicine, and industry respectively. Those bodies have done much to remove the discredit of starvation wages for scientific men, but it is obvious that they cannot do more than lead the way in the right direction and not so rapidly as to bring dislocation to the university systems.

Not only fairness, but also enlightened self-interest should provoke any nation to bring the pay of competent research workers to such a level that they may hope in middle life at least to be able to bring an education as good as their own within the reach of their children. Until that is done, we are in practice ensuring the sterility of those who, almost by definition, must be counted as amongst the most desirable begetters of our future stock.

The community has been turning more and more eagerly for fruits ripe for its own service from the tree to the development and nurture of which it has given such small care. We have been calling for the better cure of our own sicknesses and better health for our great industrial populations. Now this call is being reinforced by another, by a call for the scientific help for which the development of our Empire overseas has been waiting and upon which it is dependent at every point. There can be no right government of any part of our Empire and no true advance in the industries and welfare of the peoples within it except in the light of truth, truth in the fundamental matters of human life, of animal and vegetable life, and in the less primary but indispensable affairs of industry. No secure progress can be made save under the guidance of those who have knowledge of the realities of Nature and of the methods by which that knowledge has been gained and can alone be extended.

This lesson is at long last beginning to be painfully learned, and already the governments, both central and local, are seeking for men competent at first hand in the methods of biological and other sciences. They are seeking most urgently of all for men competent to investigate and to remove the primary disabilities opposed to all industrial development by causes of human disease or ill-health and by the diseases of the animals and the crops on which man's life depends. But they have been confronted at once with a plain dearth of competent and available men, whether in the fields of medicine or of agriculture; and so much so indeed that official representations have been made by the Government to the British universities upon the need for an increase in the supply of able men trained in the biological sciences and competent to advise them. I believe firmly that not only the development of the backward parts of the Empire but also the very maintenance of the Empire

itself in its present political form depends upon the satisfaction, and the early satisfaction, of that demand.

Our schools and universities are filled to overflowing with eager and daring youth, and our race has never failed to produce minds apt for original enterprise and discovery. Why is there this shortage of men, therefore, for work that brings the finest intellectual exercise and that gives immeasurable opportunities for service to the State in its need and to mankind at large and for ever? I think the reasons are plain, and they are well understood and have long been declared by the British Science Guild. They are reasons found in national habit and reasons found in details of present method. Our long-standing national habit, derived chiefly from the non-Grecian narrowness of centuries of unbalanced classical education—a narrowness which has hitherto denied the application of scientific method even to the technique of linguistic teaching itself—has fostered a distrust, or at best an ignorance, of the study of natural causes and of the power that it brings. Our statesmen hitherto have not been bred to trust in scientific method and to call upon it for aid. The families with the best resources, and so with the greatest responsibilities for leadership, have not in general thought it natural or even quite respectable for their sons to turn from the old traditional employments to the new avenues of public service in science to be found, for example, in medical or agricultural research.

I have tried to bring to your minds a conception of the organic growth, with its ramifications, of a tree of knowledge making the whole body of known biological truth. I have spoken of the largely unseen body of men upon whose efforts its growth depends. Mankind, helpless otherwise, has gained new powers over suffering and fuller life already from the fruits of this growing knowledge and waits anxiously for new powers again that may add to those boons. If we look at the brief period in which our present knowledge has grown, a period making an almost imperceptible point of time in the immense ages still stretching before mankind on the globe, we are encouraged to look confidently forward to a long vista of scientific progress that will bring powers of control over the processes of life, of which we can scarcely at present conceive. They will bring with them resultant changes in human society in a thousand ways now almost unimaginable. The value to the community of a body of men and women working to gain that new knowledge upon which the possibilities of greater happiness and works of greater mercy will spring is great. But it is not to be measured in terms only of those material fruits. The moral health of the whole community must gain from the presence within it of a band of workers whose business it is to seek out the truth and whose work from its nature can only go forward in strict obedience to the truth and by means of its pursuit and expression without fear and without favour. As the Dean of St. Paul's has lately said, in the scientific

life "a keen mountain air" is breathed, and something of the tonic air of this must always serve to brace and to elevate the general community.

The true worker in natural science can owe no allegiance to any tradition however venerable, or to any master however beloved. In his work he can only serve and express the truth, and for him the truth is that which can be tested by the touchstone of an appeal to Nature. He must forswear

any selfish or sectional allegiance: he is "nullius addictus iurare in verba magistri", and that phrase of Horace has become in shortened form the familiar and honourable motto of the Royal Society. If we attempt to measure the value of the scientific life within the community, we must put in the first place not the material fruits that spring from it, but the service it does to our reverence for truth and for the beauty it portrays.

The Royal Research Ship *Discovery II*.

THE launch of a ship specially built for oceanographic research is an event sufficiently rare to merit some notice in these columns. She is intended for the work of the Discovery Committee, and is for service in the South Atlantic and Antarctic, where she will be employed in biological and hydrological investigations concerned mainly with whaling. She was designed by Messrs. Flannery, Baggallay, and Johnson, consulting naval architects to the Committee, and was built to the order of the Crown Agents for the Colonies by Messrs. Ferguson Bros. of Port Glasgow. She was launched on Nov. 2 by Mrs. J. O. Borley and has been named *Discovery II*. The title 'Royal Research Ship' has been approved by H.M. the King.

The R.R.S. *Discovery II*. has an overall length of 232 ft., a beam of 36 ft., a moulded depth of 20 ft., and a draught of 16 ft. when fully loaded. She is built of steel, and in several structural features is specially designed for ice navigation. Her stem is cut away at the fore foot and is rabbeted to protect the edges of the plates from chafing. The shell plating is doubled in the bow and at the water line throughout her length, while in the fore part the frames are closely spaced and transverse beams fitted in order to resist ice pressure. She is driven by a single propeller and reciprocating engines and on her steam trials developed a speed of $13\frac{1}{2}$ knots. Her furnaces burn oil fuel, and the bunker capacity is sufficient to enable her to steam 7800 miles at full speed and more than 10,000 miles at economic speed.

The general arrangement is sufficiently shown in the illustration opposite. The wardroom is on the boat deck, with the chart room, a survey office, and the captain's accommodation above it. On the flying bridge there is a wireless direction finder and an indicating anemometer, both reading in the chart room. The wireless room is equipped for both long and short wave-lengths and is at the after end of the boat deck. Aft it is the sick bay, which is provided with an X-ray apparatus. The main accommodation is on the lower deck, the petty officers being berthed aft.

The equipment for sounding comprises a Kelvin machine on the bridge deck, a Lucas deep-sea machine on the fore-castle head, and both shallow and deep water echo-sounding apparatus of the latest Admiralty pattern. Bottom sampling instruments of various kinds will be carried, including two patterns designed to bring up cores of ooze in glass tubes.

For hydrological work and for vertical plankton nets three small winches are installed. Those on the fore-castle head and abaft the engine room each

carry 3500 fathoms of wire for deep-water observations. The third winch, placed on the well deck, has two drums of 500 fathoms capacity. These winches are used in conjunction with special davits, fitted with accumulators and recording sheaves and with electric lights for work at night. The hydrological instruments include a full equipment of water bottles of both insulating and reversing patterns, the Lumby surface sampler, the Merz-Ekman current meter, and two Carruthers current meters.

The main winch is placed abaft the engine room; it carries two drums of wire rope, one 1000 fathoms, and one 5000 fathoms in length. The wire is led outboard by way of pedestal and stern fairleads, two of the former (one on either side of the ship) being fitted with recording dials to indicate the amount of wire paid out. A derrick is fitted on the poop deck for lifting heavy gear. The biological apparatus includes plankton nets of all sizes up to $4\frac{1}{2}$ m. in diameter of opening, the continuous plankton recorder designed by Prof. A. C. Hardy, traps, dredges, and 40 ft. otter trawls. Closing mechanisms and depth gauges are provided for use with the plankton nets and a Watts current meter for registering slow speeds in towing.

The internal accommodation for scientific work includes spacious biological and chemical laboratories on the upper deck, both lighted by square windows. The former has a large gimbal table, special arrangements for supplies of preserving fluids and racks for reagents and specimen jars. The latter is fully equipped for chemical analysis of water samples, and includes also a distance thermograph, giving a continuous record of sea temperature, a chart-tracing table lit from below, and the large oceanographic slide rule recently designed by Dr. Sund.

Immediately below the laboratories, and communicating with them by means of a service lift, is a laboratory workroom with a bench, tools, and other fittings. In this room is a large vertical camera with special lighting for the photography of marine organisms, and the dark room is at the forward end. Farther aft, in the accommodation on either side of the engine room casing, are an instrument room, a laboratory for rough work in which an electric centrifuge is fitted, and a store room for plankton nets.

The ship carries 15 officers (including a scientific staff of 6) and 35 petty officers and men. She is expected to sail from London about Dec. 14, and will be under the scientific leadership of Dr. S. Kemp, with Commander W. M. Carey, R.N. (retd.), in executive command.