Perspectives in Physiology

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PERSPECTIVES IN PHYSIOLOGY

Introduction

EVER SINCE man became conscious of his own body, he has striven towards a complete understanding of bodily functions. But his search was deterred by the long delay in the development of anatomical science. Only after the structure of the body had been described correctly could the study of its functions become a recognized field of learning.

To be sure, the term "physiology" has been in existence since Greek antiquity; but it was used then to describe the investigation of all nature and applied with impartiality to the animal, vegetable and mineral kingdoms. The exclusion of inanimate matter from physiology did not occur before the 16th century. The relation of physiology to medicine was not acknowledged until a century later, largely as a result of the writings of the great Italian anatomists and their most outstanding pupil, William Harvey. Harvey pointed the way to modern physiology not only because of the nature of his discovery, but also by the method by which he achieved it: for the first time in the history of biology, exact calculations and mathematical proof had entered into research.

Only a few decades later, scientists began to apply physics and chemistry to the study of bodily functions. The successors of the first exponents of this movement, however, the so-called Iatrophysicists and Iatrochemists, were not yet able to make accurate estimates on the effects of physical and chemical forces on the actions of the body and were prone to highly exaggerated claims. As a result these movements came to an early end; but the interdisciplinary approach to science advocated by these physiologists had become generally accepted. Since the universities were at that time physically and intellectually unprepared for such an innovation, the scientists joined together to found their own academies and scientific societies. The international exchange of thought, fostered by these academies, was facilitated by the use of Latin as the

generally accepted language of the learned. Modern scientific journals and teaching laboratories are outgrowths of this movement, which sprang up simultaneously in many countries.

In the 18th century the universities began to adjust themselves to the scientific requirements of the day. The University of Leyden was one of the first to offer many of the facilities necessary for medical and physiological research. At Leyden Hermann Boerhaave drew on anatomy and physiology for his clinical practice and made judicious use of the work of the Iatrophysicists and chemists. In his lectures, published under the title *Institutiones medicae,* he dwelt largely on such physiological topics as the circulation of blood, the formation and distribution of lymph, the mechanics of muscular action, the relation of the blood to respiration, and the chemistry of the body. His book has served as a textbook in many countries and has helped to make physiology a definite part of the medical curriculum.

Boerhaave's influence was widely disseminated by his many students who spread his teachings to Austria, Germany, France, England, Scotland, and, via the University of Edinburgh, to the American colonies. In spite of Boerhaave's eclectic approach, the physiology he taught was still closely allied to anatomy and has frequently been described as *anatomia animata.* Albrecht von Haller—so frequently referred to later in this book—who, among Boerhaave's disciples, is most important for the development of physiology as an independent discipline had the same approach. It took almost two hundred years for the last ties with anatomy to be severed. Under the impetus of the work of Johannes Mueller and Carl Ludwig, the search for physico-chemical explanations of vital phenomena was once more resumed and has continued to be the basis of most subsequent study.

Boerhaave's tremendous reputation—a letter addressed simply "to the greatest physician in Europe" is said to have been delivered to him—attracted students from all over Europe. At least half a dozen of them achieved fame in their own right. Two centuries later, more than ten times as many leading physiologists emanated from the laboratories of Johannes Mueller and Carl Ludwig and spread the physiological sciences all over the world.

Yet, in 1902, Sir William Osler in addressing the Canadian Medical Association was still able to say: "The great works in the department of medicine in which a man is interested, are not so many that he cannot know their contents, though they be in three or four languages." At the time that Osler made this statement, he might just as accurately have been referring to physiology. The American Physiological Society, founded only fifteen years before with twenty-eight members—one of them being Osler—still numbered less than one hundred members. The First International Physiological Congress, held in Basel in 1889, had attracted only 124 persons. In the same year the publications important to physiology totaled 700. It was then possible for any physiologist, not only for an Osler, to be familiar with the entire scientific literature of his field.

Osler's exhortation soon lost all practical significance: when the American Physiological Society celebrated its fiftieth anniversary, its membership had increased to 631. The XIIIth International Physiological Congress, held in Boston in 1929, was attended by more than 1700. The number of pertinent publications had by then risen to 20,000 per year. Present-day publication figures have not yet been computed, but are certain to exceed by far the last-named figure. Today, although an increasingly pronounced segmentation has divided the large field of physiology into numerous subspecialties, it is hardly possible for the specialist to read the yearly share of publications in his own field, even if they are all in his native language.

Moreover, the practice of reading in "three or four languages," cultivated by some, has become increasingly rarer within the past decades. The two World Wars, interrupting the flow of international communication, forced most scientists to restrict their reading to the scientific writings in their own language.

The large attendance at the last international congresses makes it evident, however, that neither subspecialization nor enforced scientific provincialism has been able to destroy the desire for international communication or the interest in the field as a whole. But now the question arises: should the

further development of physiology be left entirely to chance; should there not at least be a world-wide awareness of the trends within this science, a general understanding of the various paths physiology is following in different countries, and of the problems that exist or are bound to arise?

While it is, of course, neither feasible nor desirable to plan a science as complex as physiology, it may be of great value to direct attention to the pitfalls and difficulties encountered by physiology and the goals towards which it is working. These points were raised by the International Council of Scientific Unions and by the Survey of Physiological Sciences, now being conducted by the American Physiological Society. The essays contained in this small volume may be considered steps in this direction.

Through the efforts of Dr. Maurice B. Visscher, leading representatives of the physiological sciences of various countries were brought together in connection with the XIXth International Physiological Congress in Montreal. As a group these outstanding scientists could deliberate on the future and limitations of physiology; as individuals they could present a picture of the past and present state of physiology in their respective countries.

The first of the several Conferences on the Future and Limitations of Physiology, under the chairmanship of Dr. E. D. Adrian, was held at a public meeting in Montreal on the 4th of September, 1953; the others took place throughout three subsequent days in Ste. Marguerite. The papers presented at the introductory session are included among the essays presented in this book. The preparation of the remaining essays contained in this book was sponsored by the Survey of the Physiological Sciences; they were written by the members of the panel of the above-mentioned symposium. The deliberations that took place in Ste. Marguerite were recorded and will eventually be published also.

In spite of the common purpose, each author has presented his thoughts in an entirely different manner: some of the essays are predominantly of a philosophical nature, while others give factual reports on the development, present state, desiderata, and technical aspects of their profession. Because

of its diversity, the book should appeal to many readers; because of its information on administrative problems it should be of value to departmental chairmen and deans. For the same reason it is hoped that this collection will be of interest to exchange students and professors, who may wish to inform themselves in advance on the professional conditions of the country they are planning to visit.

To the historian of medicine and biology the essays should be of particular value, since they furnish the basis for a "genealogy" of modern physiological thought. Moreover, they present the chronological sequence of the activity and location of many men who otherwise might be lost in the maze of historical confusion.

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WHATEVER ELSE IT MAY DO, I think this Symposium ought to make interesting reading 50 or even 100 years hence. Any one then who could look at the record of what we are going to say would certainly be cheered by finding out how many of our predictions have missed the mark. He would be less interested to read what we have to say about present tendencies but he might comment on our loyalty to a conception of Physiology which has to be defined in terms of the particular problems which have come to be studied in physiology departments. No doubt he would be amused at the unmistakable signs of regret with which we face the splitting up of our empire into a number of independent states, although we all protest loudly that it is a good thing.

We may hope that the physiologists of the future will not pay much attention to what we say, because they will find their research problems far more interesting. But although it may be a sign that we are not quite happy about the future, I think this stocktaking will be worth while. To a large extent Science takes the direction given it by discoveries that no one can predict, but a particular branch like ours is directed to some extent by the circumstances of our lives, by the economic pressures and the demands from the society we live in; we may not be able to control these and they will not let us alone to follow our noses.

Fifty years ago there was so much unexplored territory for the natural scientist that the empire of Physiology had no border country where other sciences claimed a foothold. Even biochemistry had scarcely begun to agitate for a government of its own. Zoologists studied anatomy and anatomists taught

surgeons and left histology to us. Psychologists had some prescriptive rights over vision and physicists over sound, but their incursions were too theoretical to disturb the peace. But our empire grew too large. It was an empire of convenience and administration rather than of ideas and so no one fought very hard to keep it together. There is a limit to the number of distinct lines of work which can be carried on in one building and as soon as there are too many workers to meet comfortably at tea there is not much reason to grudge some of them a building and a tea of their own.

So we had to grant independence to the biochemists, to see the zoologists claiming jurisdiction below the level of the frog and the anatomists leaving the dissecting room to make experiments. And in spite of these territorial losses our population, the number of people who are still content to be called physiologists without any qualification, continues to increase. We are faced therefore with the question that many people are asking in another context, what there will be left for us to feed on and whether we should aim at reducing our numbers by encouraging more emigration, in fact whether we should try to make any plans for the future, or whether we can afford to let Physiology look after itself.

These are subjects on which we might all talk for a long time, and we are all anxious to listen to the eminent physiologists who will speak at this Conference. I think I should be discharging my duties most effectively if I said no more, but I suppose the Chairman ought not to get away with it quite so easily and so I shall try to prepare the way by reminding you very briefly of how much the background of our work has changed.

I have implied that Physiology has lost the high rank that it once had in the scientific hierarchy, and I think it is true that the years from 1900-1930 were the time when it was advancing most rapidly and when it had the greatest power of attracting able investigators. Perhaps my chief reason for thinking that is that I was a student in 1910, so that the problems and achievemens of that time are more deeply engraved on my mind because I had to pass an examination in them. But there were great advances, with new fields opening up

and new ideas and techniques from the chemists and physicists. On the other hand, there was less money, little chance of getting elaborate apparatus unless one made it oneself, no senior posts for research without a lot of teaching attached to them and few posts for anyone who had not taken a medical degree.

The lack of endowment for Science in those days played a considerable part in keeping us all in separate divisions. Comparative physiology could scarcely develop in a zoology department which had no kymograph and histology stayed where there were microscopes enough for the classes. Nowadays it looks as though these economic factors will have far less influence, at all events in the wealthier centers of academic work. Costly equipment and whole-time research posts are not so hard to get, and although they are not available everywhere it is the well endowed places that decide the pattern.

But although we were poor 30 or 40 years ago, the other branches of biology were poorer. We had the advantage of a constant flow of medical students to support our finances and to become physiologists themselves, and as a number of very able men are attracted to medicine, we had no need to look elsewhere for potential research workers. In Cambridge, however, Physiology had also the advantage of being a subject in the Natural Science Tripos as well as in the medical course and so it could always attract a few exceptional people who had no intention of doing medical work, men like Keith Lucas and A. V. Hill.

Now that there is more endowment for branches of biology without a medical connection, we must expect that a larger proportion of our research workers will have had no medical training, but our ties with medicine have always been strong and must continue to be so. To the tax-payer who must finance scientific advance a close connection with medicine is a strong recommendation, outweighing even the claims of nuclear physics. Yet the discoveries which have immediate fruit in medical practice are coming increasingly from the whole commonwealth of sciences rather than from the particular territory which is still controlled by physiologists. We shall go on teaching medical students but we may not find

them such enthusiastic pupils, for the lectures in other departments will be just as able to interest them in the clinical applications of their subjects.

I think there is some likelihood that these changes may lead to a greater divorce between the teaching we give in the larger and more elementary classes and the research we carry out in our own laboratories. Perhaps this will not matter so much to the progress of knowledge, but I have spent a good deal of time and energy teaching Physiology to large classes and I do not look forward to a time when two-thirds of us will be whole-time research workers, skilled in micro-manipulation and theoretical physics and the remaining third have become experts at presenting the rudimentary facts of human physiology to not over bright medical students.

But it is no function of a Chairman to intrude his own preferences. It is obvious enough that Physiology will be in a more healthy state if we can all do good research and good teaching and if we can ensure the flow of able recruits to our laboratories from every branch of science without weakening our contacts with the medical sciences and the medical profession. How we are to do all these things and which of them should come first will be among the subjects that you will have to consider, but our primary concern is with the present trends and future prospects of physiological research and so I will cut what threatens to be a long story short and call on Professor von Muralt to open our Symposium.