The School of Medical Science in Oxford / by J.S. Burdon-Sanderson.

THE SCHOOL OF MEDICAL SCIENCE IN OXFORD

BY

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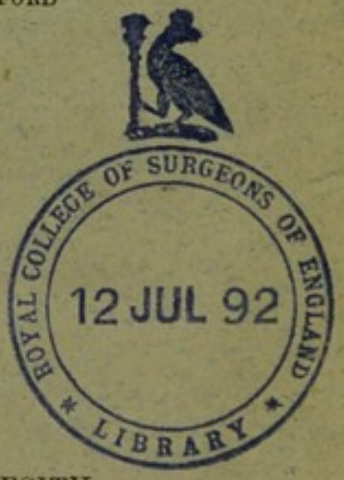
PROFESSOR OF PHYSIOLOGY IN THE UNIVERSITY OF OXFORD



Oxford

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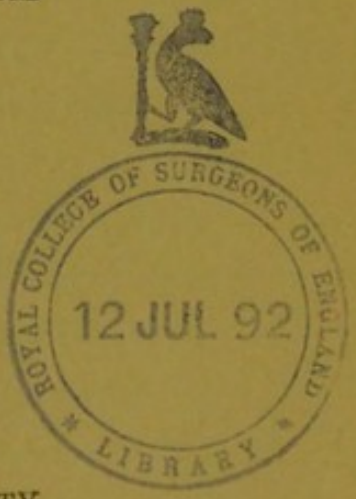

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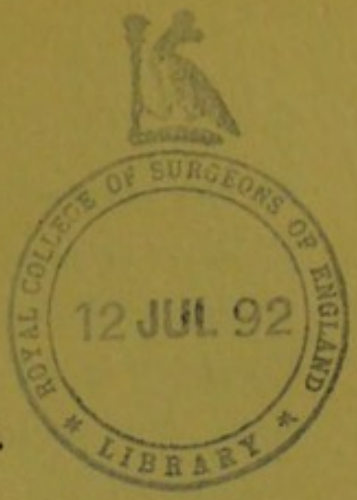
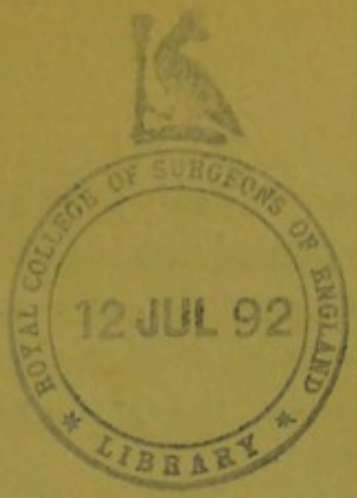


INTRODUCTION.

UNTIL three or four years ago the progress of the Oxford 'School of Medical Science' was so slow and uncertain that its very existence was doubtful. Its present more prosperous condition is due to legislative changes which have step by step removed obstacles before insuperable; and the University has very recently expressed its opinion as to the expediency of making special provision for Medical studies so decidedly, that the discussion on that subject may now be considered as closed. But in connection with it a question has arisen, the importance of which we all recognise—the question what the relation ought to be between the training which fits a candidate to compete with success for distinction in the Natural Science School, and those scientific studies which are of value to him as an introduction to the study of Medicine.

The question is one which has occupied my attention ever since I entered on my duty as Professor of Physiology in 1883. From the first I considered it undesirable to teach Physiology without reference to its application to the science of Medicine. I accordingly co-operated with the Regius Professor during the first four or five years which followed my appointment, in making arrangements

for the teaching of those subjects which are of most importance as constituting, in connection with Physiology, the basis of that science, viz. Descriptive Anatomy, and Chemistry in its physiological and pharmacological relations. But no real progress could be made until in 1888 the Statute was passed which exempted Science Students from Moderations, and enabled them immediately after passing Responsions to enter on the study of Physics and Chemistry. Since that period the number of students of Medicine has so increased, that last year the time appeared to have come for asking the University to vote a large sum for the erection of a permanent building for practical instruction in Anatomy. The willingness with which this grant was voted affords the best evidence that it is no longer necessary to advocate the claim of Medical Science to be regarded as a University study. Certain recent discussions have, however, convinced me that it is desirable to place before the University such an account of the system of study which is followed by students of Medicine, as will enable those who are interested in the subject to judge of its nature and scope, and of its relation to the work done in other sciences. In doing so I shall not fail to indicate the sources of weakness which in my judgment still exist, and the lines along which we are striving to advance.



I.

ALTHOUGH some of the sciences which are regarded as introductory to the study of Medicine have been taught in this University for a long period, it is only a few years since instruction in Anatomy, Physiology, and Chemistry has been given *as part of a medical curriculum*, or course of education to be begun here, but continued in one or other of the Metropolitan Hospitals[1]. In 1885 the University sanctioned the appointment of a Lecturer on Human Anatomy, a subject which is not usually studied for any purpose excepting that of preparation for the profession of Medicine, and a year later sanctioned the erection of a temporary building for practical instruction in the new Department. A Lecturer has since been appointed in Chemical Pharmacology, a subject which also forms part of the scientific training of the doctor, and a course of instruction in Organic Chemistry, specially adapted to the requirements of students of Physiology and Medicine, has been arranged in the Department of Chemistry. Provision has thus been made for every branch of *introductory scientific teaching* which is included in the scheme of Medical education recommended by the General Medical Council.

As in these arrangements the systematic teaching of the practical subjects, namely, the practice of Medicine, Surgery

[1] See on this subject Sir Henry Acland's pamphlet on 'Oxford and Modern Medicine.' Oxford, 1890.

and Midwifery is not included, it is, I think, plainly indicated that the study of these subjects in Oxford is not contemplated, and that in so far as there exists or may hereafter exist in connection with the University a 'Medical School,' the system of instruction so designated is purely scientific.

The teaching, not of Medicine, but *of Science as part of a system of education in Medicine to be completed elsewhere* having been determined on, it cannot be regarded as unimportant that what has been undertaken should be carried out in a manner worthy of the University.

In the following pages I propose, after stating in few words what is meant by Medical education in England as defined in the documents published by the General Council of Education, to examine the scientific training of the Medical Student as actually carried on under conditions similar to those which exist here, at Cambridge; and with this introduction place before the reader an account of what has up to the present time been done in Oxford. We shall then be in a position to consider what direction our efforts ought to take with a view to the development of the school in harmony with its surroundings.

It is probably known to all my readers that the key to the legal exercise of the Medical Profession has been placed by Act of Parliament in the hands of the General Medical Council, and that that Body has statutory authority to enquire not only respecting the sufficiency of the qualifying Examinations of Universities and bodies entitled to grant Diplomas or Licenses to practise, but also as to the *Course of Study* pursued by Candidates. A document in which the Council has set forth the principles by which it is guided in the exercise of this supervision, may therefore be

taken as more or less authoritative information as to the general nature of Medical education[1].

The principal points insisted upon in this paper are (1) That the course of professional study should occupy at least five years, and should comprise Physics, Chemistry, Elementary Biology, Anatomy, Physiology, Materia Medica, Pathology, Hygiene, Therapeutics, Medicine, Surgery, Midwifery, and certain other technical subjects (Resolution 19, b). (2) That the first year should be spent in the study of Physics, Chemistry and Biology, and that the examination in these subjects should be passed at the end of it (Resolutions 3 and 11). (3) That the last year should be entirely devoted to study at the bedside (Resolutions 5 and 8).

Medical Science at Cambridge.—The University of Cambridge is the only institution in the world which resembles ours. At Cambridge the teaching of Medical Science has been for many years in successful operation, and has consequently arrived at an advanced stage of development. It is for this reason that I have thought it desirable to precede the discussion of our Oxford arrangements by an account of the career of the Medical Student at the sister University.

A Cambridge student who comes up with the intention already formed of eventually entering the Medical Profession, begins, immediately after passing the 'Previous Examination,' to occupy himself with the subjects of the First Examination in Medicine. This corresponds in its scope with the Oxford Preliminary Examination, i. e. it comprises Physics, Chemistry, and Biology. It sometimes happens that students who enter the University at Michaelmas, possessing already a fair knowledge of Physics and

[1] See resolutions passed by the General Medical Council on June 5 and 6, 1890, in regard to Professional Education and Examination.

Chemistry, are able to present themselves for examination in all three subjects in June. But in general the examination in the above-named branches is passed in June, and the biological examination in the course of the second year —often not until the end of it[1]. These facts seem to indicate that, although the Examination Schedules differ considerably from ours, the aggregate amount of work required for the Preliminary Examination cannot be materially different.

The preliminaries having been passed, the course of study followed by the medical candidate depends on his proficiency and the order in which he intends to take the subsequent steps, viz. the examination for the degree in Arts and that for the degree in Medicine. Men of exceptional ability are able to pass the Second Examination in Medicine (which corresponds to the First Examination at Oxford) before presenting themselves for the first part of the Tripos; but at Cambridge, as here, the general course is to devote the whole of the available time which precedes the examination for the Arts degree to the subjects the candidate intends to offer. These may include—besides Human Anatomy and Physiology—Physics, Chemistry, Animal Morphology, Botany or Geology. Medical candidates naturally choose Human Anatomy and Physiology, the favourite combinations being Chemistry, or Chemistry with Zoology and Botany[2].

Although at Cambridge it is possible for a man to gra-

[1] I am informed that about 5 per cent. of the candidates pass all the Preliminaries at the end of the first year, about 40 per cent. in Michaelmas Term of the second year, and the remainder in Trinity Term.

[2] Thus in a recent examination I learn that of 65 candidates who offered the first-named subjects, 40 offered Chemistry, 7 Zoology and Botany, and 18 Zoology and Chemistry.

duate in Medicine without graduating in Arts, the proportion of students who avail themselves of the possibility is so small, that it may for practical purposes be assumed that all Medical candidates pass or attempt to pass the first part of the Tripos, which at Cambridge serves the purpose of a Final Examination for the Degree of B.A. On this account this examination plays an important part in the scientific education of the Cambridge Medical Student, and it will therefore not be irrelevant to give a short account of it.

The subjects of the examination are those above enumerated. The candidate is usually advised to select not less than two as principal subjects, but may offer a greater number. The classing of candidates depends on the 'aggregate knowledge' shown by them, but no credit 'is assigned to a candidate in any branch of science unless he appear to the Examiners to have shown a competent knowledge of the branch.' The Second Examination in Medicine is usually passed six months after the Tripos[1]. It comprises, with the exception of Organic Chemistry, the same subjects as the corresponding degree here. I am not able to say whether the standard is higher or not, but from enquiries I have made of Cambridge friends I have no doubt that it is not surpassed in extent and thoroughness by the corresponding examination of any English University.

The relative advantages and drawbacks of the Cambridge system will be more usefully discussed in a subsequent paragraph. It is sufficient to say here that the distinguished position now held by men who have been educated

[1] In the first part of the Tripos, about two-thirds of the candidates obtain a Class. Of the rest nearly half are rejected, the remainder being recommended by the Examiners for the Degree of B.A. without honour, but in some cases are required to pass an additional 'Special Examination.'

at that University during the last ten or fifteen years, affords the strongest evidence which can at present be referred to of the value to Medicine of a University training in science.

We are now in a position to proceed with the subject which immediately concerns us, viz. the scientific training which our own University affords to the Medical Student.

General Course of Preliminary Scientific Study for Medicine at Oxford.

First and second years.—As has been already suggested, the Oxford plan of study is distinguished from that of Cambridge by its greater simplicity. Whether the student intends to devote the whole of the period of residence at the University to Natural Science, or to defer entering on his scientific career until a later period, his first step in that career is to acquire such a knowledge of Physics and of Chemistry, as well as of Elementary Biology, as may not only satisfy the Examiners but be of permanent use to him subsequently. This done, he has a straightforward course before him; for all the work he is called upon to do tends to the same purpose—the acquirement of an accurate knowledge of Anatomy and Physiology, and of those parts of Chemistry and Physics which are essential to his understanding of the processes of life.

It seldom happens that the student of Medicine is able to divert his attention from his preliminary to his final subjects, viz. Applied Chemistry, Anatomy, and Physiology, until the Summer Term of his second year. That Term is chiefly devoted to Organic Chemistry, but the Lectures and

practical teaching of that subject are so arranged that time may also be found for introductory studies in Descriptive Anatomy or in Embryology.

During the third year the Medical Student attends (1) a Course of Lectures on Physiology, of which the first part aims at giving a general view of the whole subject, the second being more detailed but still elementary. At the same time he attends (2) a General Course of Histology, which runs with the preceding; (3) a General Course of Descriptive Anatomy; (4) Anatomical Demonstrations; (5) Practical Work in the Dissecting Room; (6) Practical Instruction in Histology; (7) Practical Work in Chemical and Experimental Physiology; and finally (8) (in the Summer Term) Lectures and Practical Work in Chemical Pharmacology. At the end of this year men of exceptional ability may with advantage present themselves for the Medical Examination in Anatomy and Physiology. This course can only be followed by students who, having passed in all the subjects of the Preliminary Examination not later than their fourth full Term after matriculation, have been able to make considerable progress in their anatomical studies during the preceding year[1]. As, how-

[1] In most cases it is impossible for the Oxford Medical Student to begin the study of Anatomy before the beginning of his third year. With reference to the study of Elementary Biology, now represented by Animal Morphology and Botany, the opinion of Prof. M. Foster (in a document to be hereafter referred to) expresses my own so completely, that I prefer to quote his words commenting on the Oxford Preliminary Examination. He says, 'I should prefer that in the Elementary Biology, a knowledge of the distinctive features of the more important classes of the animal and vegetable kingdom were not insisted on. It seems to me that the list of types or representatives in both kingdoms is at least sufficiently large, and that a knowledge of them with an application of general principles, is all that ought to be insisted on. In fact,

ever, that familiarity with the structure of the human body which is gained by dissection is indispensable for the understanding of Physiology, it is advisable that every student, whatever may be the order in which he takes his examinations, should attend the Anatomical Lectures and Demonstrations and go through a course of dissection during his third year.

At the end of the third year of scientific study the courses followed by the two classes of Oxford Medical Students diverge. Men who have already graduated in other schools have scarcely time even to do the work of which the outline has been given in the preceding paragraph, and necessarily leave the University to enter on their practical studies in London with a less complete scientific training. Those who aim at obtaining distinction in the Final Examination defer the study of Anatomy

I am inclined to think that a thorough knowledge of the ground covered by Huxley and Martin is to be preferred to a wider range.'

Now 'Huxley and Martin' is a small manual in which descriptions are given 'of readily obtainable plants or animals selected in such a manner as to illustrate the leading modifications of structure which are met with in the vegetable and animal worlds,' by Mr. Huxley, and 'instructions' for examining them by Prof. N. Martin. That Mr. Huxley himself would endorse the views expressed above by Prof. Foster as regards classification, may be inferred from a letter which he permits me to quote (dated Dec. 15, 1890), in which, after expressing his approval of our Elementary Biological Examinations as 'amply sufficient,' he deprecates in pointed language the putting on the shoulders of medical students a useless burden 'in the name of Biology,' and characterises systematic Zoology and Botany as subjects 'with which they have no more concern than with the manufacture of surgical instruments.' What is to be desired is that the instruction given should be efficient, without losing its introductory character. I need scarcely say that Mr. Huxley's criticisms do not relate to the instruction now given in Oxford. It is to be noted that the list of types referred to by Prof. Foster was reduced a few years ago.

until a later period, in order to devote themselves entirely during their fourth year to their Honour Subjects, attending special lectures, but mainly relying on their own reading and on their Laboratory work for the acquirement of that kind of knowledge, of the possession of which the attainment of a First or Second Class in Physiology is intended to afford evidence.

II.

In his interesting essay on 'Oxford and Modern Medicine,' Sir Henry Acland has expressed the wish, in which all who are interested in the School of Medical Science participate, that the University should be made 'the most perfect place of preparation that can be devised' for the study of Medicine. No one who has read the preceding pages need be told that this ideal has not yet been reached or even approached. I now propose to set forth what we should aim at, begging the reader to understand that what I have in view is the maintenance, not the destruction of existing arrangements, and that the progress to which I look forward consists in developing the agencies already in operation, not in creating new ones.

The knowledge which the medical man requires might be summed up under the heads of Physiology, Pathology, and Practice. Of these the first and second are scientific, the third is technical. For reasons which have been already given, we do not propose at present to attempt more than to teach Physiology and the branches of science which bear upon it directly, acting on the general principle that all the scientific knowledge which a man acquires here should be felt by him to be directly or indirectly useful in his future work. The two fundamental qualities which such a system

must possess are those of unity and thoroughness—unity derived from the relation of each subordinate study to the main purpose, which in this case is the understanding of the structure and function of the animal organism; thoroughness by the limitation of the scope of teaching and examination to subjects which admit of being completely mastered with the resources at our disposal here.

On these principles, the branches of knowledge which ought to constitute a course of preparatory study for Medicine, it being understood that a competent knowledge of Physics and Chemistry has been acquired, are (1) Descriptive Anatomy, (2) General Anatomy or Histology, (3) Applied Chemistry, (4) Applied Physics, (5) Physiology. We shall best judge of the relations of these branches by devoting a moment's consideration to each separately.

1. By *Descriptive Anatomy* is meant the anatomy of man and of the animals similar to man in organisation, as learnt by dissection. It need scarcely be said that the special attractiveness of the study of human anatomy to the student of Medicine arises out of its relation with the occupations of his future life. But, as has been already said, the practical work of the dissecting room affords to the student of Physiology, quite irrespectively of its medical interest, a kind of knowledge which is indispensable and cannot be obtained otherwise.

There are several reasons why the anatomy of man or of an animal not much inferior to man in organisation, fulfils this purpose more completely than the study of animals of simpler structure. The first is that in the most highly organised animals, the problems which concern the physiologist and the physician present themselves in their simplest form. These problems relate, not to the development of

the race or of the individual, but to the chemical and physical processes by which life is maintained, and of their relations to each other and to the whole. Consequently, on the general principle which ought to regulate the order of every scientific study, we begin with man, not with amoeba. In the protozoa, the various processes or functions of life, whether chemical, mechanical, or nervous, instead of being represented each by its own instrument or organ, are crowded into a bit of apparently structureless protoplasm—simplicity itself in form, but in function so complicated as to defy analysis: whereas, in man and animals like him in organisation, each process is so to speak carried on in its own workshop, and can be examined either in connection with or irrespectively of its connection with the life of the whole organism.

Another reason is that the fundamental notions which are embodied in the current language of physiological doctrine relate primarily to man, a fact which may be easily understood when it is remembered that in the development of physiological knowledge considerable progress had been already made in the understanding of man's bodily nature before its identity with that of animals was recognised. A third reason is that the bodily structure of man has been more carefully and minutely investigated than that of any of the lower animals, and consequently that the student by constant practice in comparing the description with the original, not only acquires the faculty of realising the forms and relations of parts, but learns how himself to describe these forms and relations in accurate language or to present them graphically or plastically.

None of these considerations militate in the slightest degree against the opinion entertained by most teachers of

Anatomy and Physiology, that a careful anatomical study of some animal or animals similar to man in structure and function (dog or monkey), would not only be the best possible preparation for the ordinary work of the dissecting room, but in itself of great value to the student.

The resemblances between the anatomy of man and that of the monkey are so close, that he who had mastered the one would find himself at home in the other; just as to a man who is familiar with a language it is easy to learn a second one which is closely allied to it. This being so, it is obviously unreasonable that the beginner in anatomical study should use the most precious of all anatomical material, when the *corpus vile* of a dog or monkey might with equal advantage be substituted for it. But quite irrespectively of any consideration of convenience, it appears to me unquestionable that the comparative method would afford to the student of human anatomy a better insight into his subject than the ordinary one, and I look forward to the introduction of this mode of study in our own anatomical department.

2. *General Anatomy or Histology*[1].—Histology is in German Universities regarded as a part of Anatomy and taught by professed anatomists. Here, at Cambridge, and in the Medical Schools of the Metropolis, it is associated, for the purposes of teaching and examination, with Physiology[2]. The association has no other ground than convenience, for

[1] Histology was first taught in England by my immediate predecessor in the chair of Physiology at University College, London, Dr. Sharpey. His students sat at a round table, the edge of which was provided with a kind of railway. On this the one microscope which served for the demonstrations circulated, so that each saw the object in turn.

[2] The association of General Anatomy with Physiology probably arose from the fact that when the microscope became an instrument of anatomical research, physiologists were the first to recognise its value and to teach what was then called microscopic or General Anatomy.

Histology is anatomical both in its subject matter and in its methods; for it is obvious that the study of the minute structure of the organism as revealed by the microscope is as truly anatomical as the macroscopical study of the same objects, by the ordinary methods of dissection. There are, however, certain chapters in the subject, particularly those which relate to the central organs of the nervous system and the organs of special sense, which derive their chief interest from the light they throw on the functions of those parts.

3. *Applied Chemistry.*—The science of Chemistry is a subject so extensive, that any attempt on the part of the physiological student to master it would be futile. But it is within his power, provided that in his preliminary studies he has acquired a competent elementary knowledge of its principles, to make himself sufficiently acquainted with those chapters of it which bear directly on Physiology. The way in which this limitation is possible can be readily understood by reference to the excellent schedule of subjects for examination in Organic Chemistry in its relation to Physiology and Medicine, which was drawn up some years ago by Professor Odling, and adopted by the Board of the Faculty of Medicine. The candidate is required first, to be acquainted with the constitution and mutual relationships of organic compounds belonging to certain groups, as well as with the chemical relations of certain other bodies of special physiological interest which cannot be included in these groups; and secondly, to be practically familiar with the scientific methods by which these relations have been ascertained or established.

The value to the physiological student of the knowledge thus indicated can scarcely be overstated. It comes to him at the very time that it is wanted, namely, when he is

making his first acquaintance with those chemical processes of animal life which it serves to explain. He is thus encouraged in his efforts to understand a difficult subject, by the consciousness that everything he learns is directly applicable to his principal study, and that the instruction which he receives in the chemical and in the physiological Laboratories respectively, and from chemical and physiological text-books, are parts of the same system and tend to the same purpose.

Thus the knowledge which the student acquires from the chemical side, of each compound or group of compounds, constitutes a bridge between exact science and Physiology. The more numerous these bridges and the more perfect they can be made, the more rapid and the more secure will the progress of Physiology be; for it is only in so far as we are able to bring the chemical actions of the living organism into comparison with the simpler and better understood processes which can be investigated in the Laboratory, that we can attain to a real understanding of their nature.

4. *Applied Physics.*—By the term Applied Physics I mean the subject which in Germany and France is taught under the title of Medical Physics. It has nothing to do with Medicine in the technical sense, but means the special applications of Mechanics, Sound, Heat, Light, and Electricity, to Physiology. The subject is not taught, so far as I know, in any University in this country, but on the other side of the Channel constitutes a separate branch of academical study, and is accordingly represented by a number of text-books, of which that of Gariel and Desplats in French, and those of Wundt and Fick in German, are the best known [1].

[1] Daniell's 'Principles of Physics' is a work of similar intention in English.

Although whatever knowledge the student may possess of Mechanics and Physics, comes much less frequently into requisition than that of Chemistry, it is scarcely less indispensable. I therefore regard the recent establishment, in connection with the Preliminary Examination in Mechanics and Physics, of practical courses of instruction in these subjects (courses which, had they been specially intended for future students of Physiology, could scarcely be better adapted for the purpose), as a very important addition to our scientific education; and I venture to hope that as our numbers increase, my colleagues may find it possible to arrange for us special courses of instruction in Applied Physics similar to those already provided in the Department of Chemistry.

5. *Physiology.*—The study of Animal Physiology is naturally divided into two parts, that of animal life as a whole, and that of the processes (or functions) which constitute it. The most useful order is to begin with a general view of the animal organism as a whole, in which the fundamental facts relating to its functions are accepted without proof, then to examine these functions or processes separately; and finally, having acquired these particulars, to re-examine them as co-ordinated by the nervous system, for the general advantage of the whole organism. Even the practical work of the Laboratory loses its interest from the moment that the idea of the organism as a living whole is lost sight of, and this is best guarded against if the study of special functions is preceded and followed by an introductory and concluding general view, the first being superficial and rudimentary, the second synthetic and as far as possible complete[1].

[1] See Addendum, p. 36.

In accordance with what has been said, any course of Physiology which pretends to completeness should consist of three stages, which may be respectively characterised as the rudimentary, the analytic, and the synthetic. Rudimentary information can be best gathered from a course of Lectures, in which the teacher aims at illustrating the more striking phenomena of animal life by vivid description and suitable demonstrations, and sets forth the accepted explanations of them dogmatically in the plainest language, but without any attempt to examine them critically. Such a course may be usefully accompanied by practical instruction of an extremely simple kind in the Laboratory. This is what is meant by Elementary Physiology as defined in the Regulations relating to the Examination in Physiology in the Natural Science School. It is Physiology for beginners, and consequently the word 'Elementary' is singularly inapplicable to it, for elementary questions are those which the beginner has most difficulty in grasping.

In the second stage, the work of the student ought to be in the main practical, for it is now his purpose to familiarise himself by his own observation with the actual working of the animal machine. He has to examine first the physiology of muscle and the various muscular mechanisms, such as circulation, respiration, bodily motion, &c.; and secondly, the chemical processes of animal life—the process of digestion, the vital exchange of material in the whole organism as well as in particular parts, and the processes by which the products of this exchange are discharged—in other words, the chemical relations of the organism to the external world and of the parts to each other and to the whole.

In the arrangement and distribution of his time he will

necessarily follow some such order as I have just indicated; for the subject, i. e. the analytic or special part of the subject, is for practical purposes divided under such headings as Animal Chemistry, Animal Mechanics, Animal Electricity and the like, each of which branches has to be studied separately, not because there is any physiological distinction between chemical, mechanical, thermal, and electrical processes, but because the knowledge and skill necessary for their investigation are derived from the various sources which their names suggest. It is at this stage in his progress, when he is working at such subjects as, for example, the chemical process of respiration, the elastic properties of muscle, the relations of pressure to flow in the vascular system, or any of those changes of which the concomitant electrical phenomena afford the only indication of physiological activity, that he feels the value—much more frequently the want—of those bridges between Physiology and the exact sciences referred to in the last paragraph.

In the third stage, which I have called the synthetic, the student starts with the purely physiological conception, that all the chemical and physical processes of life are regulated by the organism for the advantage of the whole, and that this regulation is effected by the agency of the nervous system. This being assumed, he has before him a complicated arrangement of parts in which he has already learnt to recognise centres of control, channels of influence, and peripheral offices of reception and distribution; while in his Laboratory work he has become familiar with all that is known as to the physical concomitants of the processes by which the activities of the centres and peripheral organs are aroused or suspended, and by which the changes thus

produced in them are propagated. What remains to be learnt in order to the comprehension of the organism as a whole, is the distribution of endowments of various kinds, or as it is often called, localisation of function in different parts of the nervous system, by which it is fitted for its purpose—i. e. to be the instrument by which the infinitely varied activities of the organism are subjected to the whole. The modes of enquiry which relate to this region are not, like those with which the student has previously had to do, borrowed from other sciences, but are distinctively physiological; for in the localisation of function in the nervous system, all the knowledge that we possess has been gained by experiments having for their purpose to observe, in respect of each organ or part, in what way the process over which it presides, be it mechanical, chemical or other, is modified when the part in question is accidentally or intentionally interfered with so as to diminish, arrest or augment its activity.

For reasons which cannot be here dwelt upon, it is impossible to afford to the student the opportunity of verifying these experimental results. That he loses thereby very materially cannot be questioned, for although the universal use of the graphic or other automatic methods of recording these results, may enable the *trained* observer to realise the details of an experiment performed by another person almost as completely as if he were actually present, the needful insight cannot be so gained in the first instance. I therefore maintain that the opportunity of witnessing some of the fundamental facts relating to the elementary functions of the nervous system, now under consideration, should not be withheld from the advanced student.

There are several other branches of study which might with advantage be added to those of candidates in the Final Honours Examination in Physiology, were it not that we are not as yet in a position to teach them. Among the most important of these is Physiological Psychology, the name of which implies that, as regards its matter and its methods, it is as much a part of Physiology as of Psychology. As yet the facilities which Oxford affords, either for study or research in the path opened out in recent years by experimental psychologists, are very limited. If, however, as there is now some reason to hope, a closer relation were to establish itself between men who regard psychological questions from opposite sides, and were to result in mutual co-operation for the purposes of teaching, there would be little or no difficulty in providing facilities. The establishment of such teaching would unquestionably fill up a *gap* in our system of physiological study, and I venture to think would not be without its corresponding advantage to psychologists.

Another subject to which I should wish to refer—the Physiology of Plants—is excluded by the title of the Examination. This branch can be defined in terms which closely correspond with those which I have used in the sketch I have given of Animal Physiology, almost the only difference being that those chapters in the latter which specially relate to the nervous system have no counterparts in the former. But as regards the nature of the vital processes of plants and animals, and the means by which they are severally studied, there is no distinction. Ought not therefore the physiology of plants to find its place in our 'Final' Schedule? The *practical* answer is that Oxford students have such excellent oppor-

tunities of studying the physiology of plants in the courses which are now given at the Botanic Garden, with a view to the Preliminary Examination in Botany, that the subject is sufficiently provided for. Moreover, I do not think that any question relating to the Physiology of Plants which could be shown to bear, as every such question if sufficiently general must do, on the Physiology of Animals, would be out of place if set in the Final Examination in Animal Physiology.

III.

I propose, by way of conclusion, to submit to the reader a comparative estimate of the educational value of the courses of scientific study preparatory to the study of Medicine at Oxford and Cambridge.

It has already been seen that whereas Cambridge affords to its students a complete curriculum of Medical education, including the practical subjects as well as the scientific, we limit ourselves to the latter. As, however, a very large proportion of Cambridge students do not avail themselves of these advantages, this difference between the two Universities need not be taken into consideration in relation to the present question. What we have to compare is not the Cambridge 'Medical School' with the Oxford, but the Cambridge scientific training for Medicine with that which is to be had here. It must further be borne in mind that the course of study of the graduate-student is not referred to.

As regards the first two years it has been shown (p. 10) that there is no important difference between the two systems. Although at Cambridge the examination in Physics, Chemistry and Biology, which corresponds to our

Preliminary, is designated the First Examination for the Degree of M.B., and is only passed by Medical students, this has no practical effect, excepting that at Cambridge the Medical Student is compelled to specialise from the first, whereas here he need not determine the question of his future career until a later period. We may therefore limit our comparison to the period intervening, in the case of medical aspirants for Honours in the Natural Science School, between the passing of these examinations and the completion of the strictly scientific part of his curriculum—a period which (in nine cases out of ten) corresponds in both Universities to the third and fourth years of residence.

This being understood, it may be stated generally that the difference between the work of the Oxford and the Cambridge student during his third year is determined almost exclusively by the character of the examination which each has in prospect, namely, the first part of the Tripos, and the Final Examination in the Natural Science School. The essential difference in these examinations is that whereas an Oxford First Class is understood to denote proficiency in *one* science, a First Class at Cambridge may be taken as evidence of competence in several (see p. 11). As regards the Cambridge examination there are two other circumstances which are of importance in their relation to the scientific training of the Medical Student, namely, first, that it is passed at an earlier period, and secondly, that two of the subjects which may be offered (Human Anatomy and Physiology) are identical with those of the subsequent examination in Medicine, and that in consequence there is at Cambridge a more complete blending of the scientific with the medical courses of study and examination than even at Oxford.

Proposals having been made by some members of the University whose opinions are entitled to respect, which if carried into effect would tend to assimilate our system of teaching in medical science to that which exists in Cambridge, it has become necessary to state shortly the considerations which, in my judgment, render it undesirable to make any change in this direction. These considerations are first, that the present arrangements were originally adopted by the Board of the Faculty of Science after the most careful and prolonged deliberation, and were brought, by successive stages of legislation, to their present state of completeness; and secondly, that the experience which we have had since that time of their operation, has afforded evidence of their satisfactory character. I will first give an account of the circumstances which led to the rejection of the principle of 'cumulation' of subjects in the Final Examination of the Natural Science School.

It is now nearly twelve years since the question whether or not candidates in Biology should be required to offer two or more subjects in the Final Examination first came under discussion. I was at that time (1880), as Examiner, a member of the then existing Board of Studies, and prepared a statement of my views as to the principle of 'cumulation' which, before bringing them forward, I submitted to the late Professor Rolleston. He objected to my proposal on principle, his opinion being that which is now held by some of my colleagues. 'I wish,' he says, in a letter dated Oct. 24, 1880, 'a man to offer two of the great subjects.' Accordingly, when the question was discussed (Nov. 10, 1880), a resolution was proposed by Professor Rolleston 'that candidates in Morphology and Physiology should have their answers judged of cumula-

tively,' which at that time was accepted by a majority of the Board.

A year later (Jan. 29, 1881) I again brought the subject forward, my seconder being Professor Ray Lankester, who as my co-examiner was also a member of the Board, which by that time had so far changed its opinion that we succeeded in carrying a resolution to the effect that a candidate might offer one subject or more subjects at his discretion. The opinion which I then entertained was the result of experience. I had at that time just completed my period of office as Examiner here, and had shortly before performed the same duty at Cambridge. I, rightly or wrongly, attributed the unsatisfactory performance of most of the candidates to the circumstance that, in accordance with Professor Rolleston's principle, they had been required to come up to the Honours Standard in two great subjects instead of one. I was further encouraged by the strong opinion expressed by Professor Lankester against the principle of 'cumulation,' as founded on his long experience, not only as an Examiner, but as a Biological Teacher in Oxford.

After this the subject was allowed to drop, until the late Professor Moseley, shortly after his appointment as Linacre Professor, in conjunction with Professor Lankester, submitted to the Board (Feb. 18, 1882) a complete scheme of examinations, in which my original proposal was embodied, with this difference, that whereas I had desired that candidates should be allowed to offer two subjects if they thought proper, Professor Moseley proposed that candidates should be limited to one subject. Considering the importance of these proposals, I repeat them here.

1. 'That no Candidate for Examination in the Honours School of Natural Science shall be permitted to be examined at the same Examination in more than one of the three Branches of Biology, namely, Branch I, Botany; Branch II, Animal Morphology; and Branch III, Animal Physiology.

2. 'That the particular subjects in which Candidates have obtained a Class in the Natural Science Honours Examination be indicated by means of explanatory letters appended to their names in the published Class Lists.

3. 'That any Candidate who has qualified for a Degree at the Honours Examination in any one of the three Branches of Biology, be permitted to enter at any time up to the twentieth Term from the Term of his Matriculation for the Honours Examination in either of the remaining Branches, and, if he obtain a Class, be placed again in the Class List accordingly.

4. 'That a Preliminary Qualifying Examination in the elements of the three Branches of Biology be held once annually, immediately before the Final Honours Examination, and that Candidates be permitted to enter for it at any time after their Matriculation.

5. 'That all Candidates for the Final Honours Examination in any of the three Branches of Biology be required to have previously satisfied the Examiners at the Preliminary Qualifying Examination in the two Branches other than that in which they present themselves at the Final Honours Examination.'

The scheme was referred to a large Committee, and adopted by them, and eventually communicated by the Chairman of the Board, Sir H. Acland, to the new Board of the Faculty of Science, by whom it was unanimously

accepted and communicated in the following form to the Hebdomadal Council.

'The subjects in which a Candidate may offer himself for examination at the Final Honours Examination in the Natural Science School are at present three only: Physics, Chemistry, and Biology. It is recommended that the number should be increased, and that they should be the following, viz. (1) Chemistry, (2) Physics, (3) Animal Physiology, (4) Animal Morphology, (5) Botany, (6) Geology.

'At present Candidates are permitted to enter at any Final Honours Examination for which they are qualified, in all the recognised subjects or any combination of them. It is recommended that of the last four subjects named above only a single one be permitted to be taken up at any one Final Honours Examination by any Candidate.'

On this Report the changes in the Statute concerning the School of Natural Science were founded. As regards the recommendation of the Board of Natural Science that 'only a single subject should be permitted to be taken up,' the candidate was left at liberty, in accordance with my original proposal in 1882, accepted by the Board of Studies, to offer either one or more of the six subjects at their discretion. That the Committee of 1882, itself a large and influential one, spared no pains in investigating the whole scheme submitted to it, may be judged from the circumstance that before arriving at a conclusion it obtained advice from all the leading authorities on it in this country—among others from Mr. Herbert Spencer, Professor Thiselton Dyer, the late Professor Allen Thomson, Sir W. Turner, Professor Huxley, the late Dr. Carpenter, Professor Michael Foster, Mr. Poulton, and Mr. Hatchett Jackson. Only a few of these gentlemen, whose names

I give in alphabetical order, expressed any opinion on the question of limitation versus cumulation, viz. Dr. Carpenter, Professor Dyer, Professor M. Foster, and Dr. Allen Thomson; but each of these expressed his opinion in the most decisive way in favour of the former principle.

Dr. Carpenter writes—'I do not think it possible that a man can prepare himself for such an examination as is contemplated under Schedule B without at least *two years hard work at one of the three specified subjects*; and I do not think that he ought to *begin* this until he has passed the examination under Schedule A, for which he might prepare at the same time with the examination in Elementary Chemistry and Physics, so as to make the whole a sort of *First* Science Examination[1].'

Prof. Dyer, after referring to the Cambridge Tripos, in which he states that at that time it was possible 'to obtain a First Class in any one Branch—Physiology, Botany, or Geology,' adds, 'I can speak decidedly in favour of the satisfactory results immediately attained.' He then goes on to describe the rapid progress of botanical studies at Cambridge (under the direction, I believe, of our present professor, Dr. Vines), attributing it to the recognition of Botany 'as a clear subject.' Further on he remarks, with reference to the often repeated allegation that the limitation principle leads to too much specialisation, 'My answer is, that as a matter of experience, unless students are introduced to special studies at the Universities, it is the rarest thing for them either to engage in them afterwards or to make any satisfactory progress if they do.'

Prof. Michael Foster, as might be expected, enters on the question more fully than the rest. He says—'I quite agree

[1] The italics are Dr. Carpenter's.

with the scheme, if, as I understand it, it provides that all candidates in Biology should pass, first, an Elementary Examination in General Biology, second, an Examination in *either* Physiology, Animal Morphology, *or* Botany. Whether the interests of science or of the learner (and that both as concerns professional education and general culture) be considered, it seems to me of highest moment that there should be a broad general basis, and afterwards that the student should be encouraged to specialize. I should prefer that he should be *encouraged* rather than *compelled*, but think it best to compel him to specialize as in scheme before me, if the only alternative is to encourage him to take up more than one subject. I think the system at present in operation, whereby the candidate is led to attempt to study several subjects, distinctly bad, and that the scheme proposed by Professors Moseley and Lankester, is a marked step in the way of improvement.' After commenting on the Schedules he closes in these words—'In conclusion, I cordially agree with the scheme on these points:—

1. 'An initial Examination in General Biology, compulsory on all—of an elementary character, with few questions, most of which are to be answered.

2. 'A Final Special Examination limited to one of the three divisions, with questions of high order, covering, in the course of the Examination, the whole field of each branch (by selecting certain points in each subdivision of the subject), considerable choice being left to the candidate.

3. 'A Searching Practical Examination.'

Finally, Professor Allen Thomson gives his opinion as follows:—

'I may say that the proposal to separate the three

branches of Animal Morphology, Animal Physiology, and Botany in the Higher Examination for Honours meets with my entire approval. I consider it to be quite impossible for any candidate, during the three years which I presume is the whole time that may be usually devoted to the study both of an elementary and advanced kind, to acquire such a knowledge as would be valuable to himself, or productive of any reflective influence on the progress of science, in more than one of these three departments.'

From the above passages it will be seen that the opinion of the eminent persons who were consulted were perfectly unanimous in preferring specialisation, or as I prefer to call it, unity and thoroughness, to cumulation.

The second reason why I regard it as in the highest degree unadvisable to make any change in our Final Examination so far as relates to my own subject, is that since the passing of the Statute of 1888, by which the University gave its final sanction to the present system, its working has been in the highest degree satisfactory.

The time which has elapsed since the passing of this Statute has not been more than sufficient to render it possible to judge of its operation; but the rapid numerical increase in the number of men reading for the Natural Science School affords already sufficient encouragement. All the legislative changes which, during the last ten years, have been made in that School (and which to members of the University who are unaware of the difficulties we have had to surmount appear needlessly complicated) have been consecutive steps in the development of a system which has so far reached completeness, that no further changes seem to be wanting excepting such as may be required for the adjustment of details so as to

ensure efficiency of working. So far as my own subject is concerned, I have nothing to ask excepting that we who are engaged in the teaching of science for Medicine may be allowed, in co-operation with our colleagues, without disturbance to give our whole energies to the work we have undertaken.

Of the many defects in our system of teaching, the greater number are of such a nature that as the School progresses in numbers they will remedy themselves. I refer particularly to the present impossibility, for want of a sufficient number of teachers, of dealing with many branches of study which it would be desirable were it possible, to include in our programme. Anatomy and physiology together form so large a subject that it is not possible, even with the efficient assistance I receive from my coadjutors in the Laboratory and from other sources, to provide for the teaching of all its branches; but as numbers increase we may confidently anticipate that men who have devoted their attention to special chapters of the subject will find it worth while to give their aid in rendering Oxford, in the words of the Regius Professor of Medicine already quoted, 'a place of the most perfect preparation that can be devised for the study of practical medicine.'

ADDENDUM.

It has been suggested to me that there may appear to be a distinction between Physiology as a Science and Physiology *for medical students*. If there is any one who thinks so, I would ask him, in case he is not satisfied with my assurance of the contrary, to satisfy himself on the subject by comparison. He will find that there is nothing in the Regulations of the Board of Faculty of Medicine relating to the examination of medical students in Physiology, which is not also represented in greater detail in the corresponding Regulations of the Board of the Faculty of Science. If he desires to pursue the question further he may institute a similar comparison of Prof. Hermann's 'Handbuch der Physiologie' in six octavo volumes, or Prof. Foster's Treatise in four volumes, with any of the one volume Text Books specially intended for medical students. Nothing will be found in these which is not much more fully discussed in the larger works. In a word, there is no such thing as 'Medical' Physiology.

The comparison I have been led to make of the Cambridge plan of study with our own, has brought under my notice several particulars in respect of which Cambridge appear to have the advantage. To these I hope on a future occasion to draw attention. For although there may be no reason for adopting the Cambridge system as a whole, it is not the less desirable to graft on our own whatever arrangements can be shown to be likely to conduce to efficiency.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