PREMEDICAL ZOOLOGY

BY

M. ABERCROMBIE

AND

M. L. JOHNSON

Zoology Department, University of Birmingham

In the present widespread discussion of medical education the teaching of premedical science is not receiving the detailed criticism it deserves and needs. The Goodenough Committee¹ recorded much dissatisfaction with the usual course of instruction, but made no concrete suggestions about the scientific background which medical students should have. The Moran Committee² made some valuable points about the university premedical year, but left details to the teachers concerned. It is desirable that teachers of premedical science should state their views for criticism by their medical and scientific colleagues. In offering the following suggestions for modification of the zoological part of the First Medical Course we are assuming that at least for several years a considerable proportion of students will continue to take this course at a university. We feel, however, that our proposals are also relevant to premedical teaching in schools.

It is generally agreed that zoology can contribute two things to medical education: (a) Training in scientific attitude. Zoology, the nearest of the premedical sciences to medicine, is particularly suitable for the initial training of medical students in scientific method. (b) Knowledge of biological principles basic to medical science.

In order that these contributions shall be adequately made, we believe that there are two major necessities, in both of which contemporary courses are seriously deficient: (1) *A large part of the teaching must be primarily and deliberately directed to training in scientific method.* (2) *Factual material must, where possible, be drawn from the biology that is important to man and relevant to medicine and not from "pure" or "academic" zoology.* We will discuss these two points separately.

(1) Training in Scientific Method

Our experience of zoology teaching has shown us that the assimilation of scientific facts does not of itself automatically lead to an understanding of scientific method, nor does it inculcate scientific habits of thought. The essentials of scientific method must be quite explicitly taught, and training in scientific habits quite deliberately undertaken. Such instruction is not specifically provided for by the usual university teaching techniques of lectures and demonstrations, which are designed to present factual material as quickly and easily as possible. Indeed, however much the intention of training in scientific method is affirmed in syllabuses, one can find little trace of it in examination questions, which may be taken as indicators of both the treatment and the content of a course, and which certainly strongly condition the attitude of students. The traditional system of instruction thus contributes to, or at any rate fails to correct, the deficiencies of the average medical graduate noted by the Moran Committee²: "He tends to lack curiosity and initiative; his powers of observation are relatively undeveloped; his ability to arrange and interpret facts is poor; he lacks precision in the use of words." It is as though we fed our students always through a stomach-tube. We choose their meal carefully, prepare it suitably, insert it efficiently, and deny them scope to develop the use of their senses, powers of discrimination, and voluntary muscles. Training in scientific habits must be the primary business of much of the teaching and not, as traditionally, a subsidiary and often imaginary by-product of factual instruction.

For instance, one of the most important scientific habits for successful medical practice is that of unprejudiced observation. Yet it is usual to give students full information about material they will subsequently see in the laboratory. This may be the quickest way to get students to absorb as much knowledge as possible in a short time, but it is not the best way to train them to observe carefully, to record accurately, and to interpret

what they see. Indeed, results of an experimental class test showed that pre-knowledge in students of what they expect to see *inhibits* careful observation.³ Many practical classes should be designed to make students find things out for themselves, even if the factual knowledge they so acquire is only a small fraction of what traditional methods give them in the same limited time. In our opinion it would be far better if students were taught less and found out much more.

We do not propose in this article to be more concrete about methods of training in scientific method, partly because we want to emphasize generalities, partly because the necessary new teaching techniques cannot be deduced from first principles, but must be developed by deliberate experimentation. We might suggest from our experience, however, that, since an important part of zoology practical classes must consist of training in the technique of dissection, a useful step is to give dissections so far as is possible in the form of problems. Training in observation, recording, and interpreting can be introduced at many points in practical work. We have found training in the process of experimentation more difficult to devise; biology is here at a disadvantage in comparison with physics and chemistry. It is difficult to find valuable experiments which are not better done subsequently in the physiology course. Finally, it is important to introduce students to elementary statistical procedure.

(2) Subject-matter of the Course

We now come to consider the subject-matter. It is our opinion that those aspects of zoology which are relevant to human affairs have most to contribute to medical education. We will discuss our reasons for this opinion under two headings: (a) the value of what we may call "human" zoology as part of the mental equipment of students; (b) the value of human zoology in promoting the process of learning.

(a) Human Zoology and Mental Equipment

It is surely a reasonable view that biology relevant to human affairs should be an essential part of the culture of a citizen of democracy, because control of the development of human society demands such knowledge. This attitude has been expressed recently by Hogben,⁴ and we need not discuss it further. If, however, human biology is important for every citizen, it is doubly important for doctors. Medicine is, after all, a field of human biology, and doctors are directly concerned with many biological problems.

The content of most elementary syllabuses, however, has clearly not been designed with the above consideration in mind. The relative emphasis given to different major principles or branches of zoology is quite arbitrarily determined in the traditional course. It certainly cannot be said to give a balanced picture of modern academic zoology. Still less does emphasis in the course reflect importance for the general citizen. The principles of comparative morphology are chosen for special emphasis, though this is perhaps the least important branch of zoology when man is the centre of interest. More important principles may also be taught, but almost always with illustration by factual material of unnecessarily little human interest—for example, parasitism exemplified by *Monocystis* and *Taenia*. A great deal of factual material has neither relevance to any biological principles nor any intrinsic human importance—we refer especially to much of the detail of the "type" animals and embryos.

It may nevertheless be said that the educationally important principles are most soundly taught in the traditional way through carefully selected aspects of "pure" rather than through "applied" science, and that application of the principles to practical problems can be left to the student to make as he finds it necessary. We cannot agree with either of these contentions. Useful animals and plants exemplify most biological principles just as well as those which have no social importance. For instance, the principle of the circulation of matter can be taught as well through the biology of fisheries or of sewage disposal as of ponds or heaths. And the principles of physiology can be taught as well with reference to man as to the traditional frog; indeed, better, since human physiology is so much better understood.

As regards subsequent application of general principles to practical problems, it is the usual experience that a general principle is not at all easily applied in an unfamiliar context. A student is likely to apply his knowledge of general principles to human affairs only if he already knows how it does apply. An interesting experiment has shown the advantage, from the point of view of handling social problems, of integrating human applications with scientific fundamentals in the teaching of genetics.⁵

(b) Educational Value of Human Zoology

The educational value of a zoology syllabus which takes man as its centre is not the only point in favour of such a course for medical students. We believe that the material will be more readily learned and retained than will that of traditional zoology. As a recent report⁶ points out, human zoology has the advantage of starting from the everyday biological interests of all students. Its particular importance for medicine can easily be made plain. The interest of the keen medical student who tends to be impatient of the apparent irrelevance of the traditional course is therefore readily captured, and learning is much facilitated. Further, if the subject-matter is relevant to medicine, there is less danger that the biological principles which the course illustrates, and the scientific attitude which it is supposed to inculcate, will be jettisoned as the student proceeds to his medical studies. He will be reminded from time to time of his biological training, and a real link between pre-medical and subsequent years will be developed. The importance of making such links between the various parts of the medical course is emphasized by the Goodenough Committee.¹

A link can, for example, readily be made with the preclinical years by discarding, in lectures on vertebrate anatomy and physiology, all "type" animals except man. These lectures can put the most general aspects of human anatomy and physiology into their background of the anatomy and physiology of all animals. The amount of duplication of preclinical work will obviously be negligible in a short course, but the material can be made a useful introduction to subsequent work and a permanent link between broader biological principles and later specialization.

We have recently also experimented with the frequent use of medical exemplification in discussion of physiology, parasitology, and genetics in order to make quite clear to students that the general principles they learn are a valuable part of their medical training.

Here we are on controversial ground. While most educationists would agree that every attempt must be made to give sound training in scientific method, and many might agree that emphasis should be put on the *human* aspects of biology, we are well aware that our suggestion that biology should in addition be given a *medical* flavour may seem to run counter to the commonly held view that premedical science should be non-vocational. Let us explain, however, that we do not propose that students should in any sense be given a preliminary course in medicine, but merely that when the course can be illustrated and exemplified by obvious applications to medicine the opportunity should not be missed. Advantage should be taken of the fact that, for instance, the pathology of processes is sometimes a convenient natural experiment which reinforces the evidence for any generalization. And for examples of parasites we prefer to use those of medical importance—the malaria parasite rather than *Monocystis*, and hookworm rather than tapeworm.⁷ The number of medical facts which students learn in this way will be negligible; their importance lies in capturing the interest of the keen medical student and to some extent in helping to integrate biological with subsequent medical studies.

Such a medical flavour introduced into our zoology course during the last two sessions produced a strongly favourable response in anonymous questionnaires returned by students. To adapt a legal dictum, we may say, therefore, that a premedical course should not only be relevant to medicine but be manifestly and obviously seen to be relevant.

We have indicated that we believe that human zoology is a more suitable general training for every kind of student than the traditional first-year zoology. We have no need, therefore, to segregate medical from science students, and we agree with the Goodenough Committee that such segregation is undesirable in the early stages of education. We should add that the intro-

duction of a medical flavour into elementary zoology does not necessitate such segregation. The time occupied by medical exemplification is inconsiderable, and, incidentally, science students also find such a course more interesting than the traditional one.

Conclusion

We suggest, therefore, that the subject-matter of a premedical course should be designed as an introduction to the study of man in relation to other animals. To clarify our proposals we give in brief outline the sort of course in zoology we have in mind.

1. The earth as a habitat; the circulation of matter and the place of animals therein; the animal kingdom and man's place in it; the history of animals.
2. The physiological anatomy of man against a background of other animals and in relation to habitat. This survey should be discussed round a central theme, such as the maintenance of constancy of the internal medium in the land habitat.
3. Sex and development, omitting details of morphological embryology.
4. Genetics applied to human and agricultural problems. Special emphasis should be placed on the relation of nature and nurture, which is of such fundamental importance in medicine and social science.
5. Evolution; the uniqueness of man; the contrast between cultural and organic evolution.
6. Pests and parasites of man and domesticated animals and plants, and their control; in particular, malaria and hookworm studied from biological and social aspects.
7. Animal populations and the relations between animals; food chains illustrated by the biology of fisheries and of sewage disposal.

Throughout the course a deliberate attempt must be made to inculcate desirable habits of thinking. While this can be done during lectures by explicit precept and by implicit example, the process would undoubtedly be very much speeded up if staffing arrangements would allow the development of a tutorial system. The following points are among those we think should be insisted on:

Elementary semantic discipline: avoiding verbal confusion; understanding the potency of "word magic."

The changing system of knowledge; the importance of flexibility of mind and of avoiding dogma.

The importance of unprejudiced observation and of controlled experiment; the evaluation of evidence from a variable population obtained with variable techniques; the role of techniques and their limitations, including the use of experimental animals.

Summary

To play a useful introductory part in the medical course, pre-medical zoology should concentrate on: (1) training in a scientific approach to biological problems; (2) provision of an introduction to the study of man in relation to other animals.

REFERENCES

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- 3 Johnson, M. L. (1942). *School Sci. Rev.*, **92**, 56.
- 4 Hogben, L. (1942). *Ibid.*, **91**, 263.
- 5 Bond, A. De M. (1940). *An Experiment in the Teaching of Genetics*, New York.
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Official figures show that the number of blind persons in this country has increased by nearly 150% in the past quarter of a century. The number was 30,785 in 1920; it has risen to 76,145 in the latest count. But the National Institute for the Blind explains that the statistical increase may be more apparent than real, as the official figures refer only to people who have been actually registered as blind. The registration system is much better to-day than it was 25 years ago. At the same time the Institute considers there is much more blindness than need be, and that thorough preventive measures should be taken. It does not intend to make any separate appeal for this part of its work, but it is urging the Government to include ophthalmology in the National Health Service. One urgent need, according to the Institute, is the creation of more research and treatment centres similar to that at Oxford. There should also be a vigorous campaign to make the public "eye-conscious," more aware of the dangers that threaten sight.