

of the Deity make no appeal to any special sense, only a universal appeal; and our methods are, as we know, incompetent to detect complete uniformity. There is a principle of relativity here, and unless we encounter flaw or jar or change, nothing in us responds; we are deaf and blind, therefore, to the immanent grandeur around us, unless we have insight enough to appreciate the whole, and to recognize in the woven fabric of existence, flowing steadily from the loom in an infinite progress towards perfection, the ever-growing garment of a transcendent God.

SUMMARY OF THE ARGUMENT

A marked feature of the present scientific era is the discovery of, and interest in, various kinds of atomism; so that continuity seems in danger of being lost sight of.

Another tendency is toward comprehensive negative generalizations from a limited point of view.

Another is to take refuge in rather vague forms of statement, and to shrink from closer examination of the puzzling and the obscure.

Another is to deny the existence of anything which makes no appeal to organs of sense, and no ready response to laboratory experiment.

Against these tendencies the author contends. He urges a belief in ultimate continuity as essential to science; he regards scientific concentration as an inadequate basis for philosophic generalization; he believes that obscure phenomena may be expressed simply if properly faced; and he points out that the non-appearance of anything perfectly uniform and omnipresent is only what should be expected, and is no argument against its real substantial existence.

OLIVER LODGE

THE TEACHING OF COLLEGE BIOLOGY

IN schools below college grade it is considered eminently desirable and necessary that the teacher shall have given some attention to the art of teaching. It is furthermore expected that he keep himself informed through meetings, reports, journals and discussions of progress in the art as well as the science he is expected to teach. He is expected to keep in touch with new ideas, in the subject matter and in the best methods of presenting them to his classes.

There appears to be a sharp distinction in this respect between these schools and colleges or universities. As a rule, college teachers are not expected to annoy themselves with principles of education or with methods of teaching. To do so is to ally oneself with prep. school ideas and associations. To be in open sympathy with any effort to arouse interest in the teaching side of one's profession is to lose caste with one's colleagues. Though primarily employed to teach, the consideration of one's specialty from the teaching standpoint is considered a necessary evil to be tolerated but not encouraged. Each new appointee is expected to adopt the university methods of his teacher or to stumble upon a plan which so frequently is a compromise between the limitations set by the institution and the bias of his training and experience, with little or no regard for the real needs of the student.

Very slowly there has developed a growing consciousness that the plans and methods that served so admirably during the last generation no longer met the needs of the college man or woman of the present day, particularly in the natural sciences. And the opinion has frequently been expressed that an exchange of ideas and experiences by men from different colleges or universities of the country would tend to clear the ground for an understanding of the nature and scope of the biology courses in schools of college grade. It was felt that the first effort should be directed toward a study of the introductory course in biology, the only one that the great majority of college students ever take.

During the summer of 1911 a number of biologists¹ met at Woods Hole, Mass., to discuss the nature and scope of the first year's or introductory course in the natural sciences in schools of college grade. It was agreed that very profound changes in the preparation of the student, in educational policies, in the attitude of the student and the public toward the science, and the great progress in the science itself, made it imperative that the college course be correspondingly modified in the light of these changes. It was also agreed that narrow standardization or uniformity was impossible.

The courses as outlined by each person present made it very evident that there was considerable agreement in certain fundamental principles and tendencies, namely: (1) a tendency away from the narrow study of comparative morphology; (2) a tendency to include fewer types, studied from a wider viewpoint; (3) a tendency to emphasize the study of living organisms in relation to their environment; (4) a tendency to emphasize physiological processes; (5) to include the consideration of the relation of living organisms to man; (6) to include the consideration of general and fundamental phenomena, and some of the big problems that biologists are endeavoring to solve.

Unfortunately time did not permit an adequate discussion of what appears to the writer to be a very important phase of the problem, namely, to what extent should the student be made to realize the methods used in the investigation of biologic phenomena, and the nature of the value of biologic evidence. It would be extremely useful if Professors Conklin, Calkins, Lefevre, McClung and others present at the meeting could be persuaded to make their plans and experiences public.

¹The men present were: Professors Calkins of Columbia, Conklin of Princeton, Goldfarb of the College of the City of New York, Kellicott of Goucher College, Knower of Cincinnati, Lefevre of Missouri, Lewis of Wisconsin, McClung of Pennsylvania, Montgomery (who recently died), Moore of Washington University (St. Louis), Parker of Harvard, Patterson of Texas, Pike of Columbia.

The results of the meeting suggested the desirability of obtaining certain data from a larger number of institutions, in the belief that they might serve as a basis for a more general and open discussion of a difficult and important problem. Fully conscious of the limitations of such tabulated data, they are nevertheless submitted, as obtained from over fifty colleges and universities. Over ten, not included in the tables to follow, were so incomplete as to make their inclusion of very questionable value. By request, the names of the contributors are not mentioned. I wish to express my thanks to all who so kindly co-operated in furnishing the data called for.

OPTIONAL OR REQUIRED INTRODUCTORY BIOLOGY

The term biology is here used in a very loose sense to mean any introductory course in the natural sciences offered in colleges.

Number of Colleges	
40	Biology is required at least of certain groups of students.
4	Biology is not required, optional only.
1	Biology is not offered at all, except one term of elementary physiology.

Number of Colleges	Length of Course	
5	one half year	Required
33	one year	Required
4	one year	Optional
1	two years	Required
1	three years	Required

PROPORTION OF THE STUDENT BODY WHO TAKE INTRODUCTORY BIOLOGY

A very small part of the student body take or have taken this introductory course, as shown by the following table:

No. of Colleges	Per Cent. Students
2	100
1	90
3	50
9	33
2	20
14	10
2	2½
7	*

* Doubtful.

STUDENTS IN INTRODUCTORY COURSE GROUPED
ACCORDING TO THEIR OFFICIAL CLASSES

Per cent. of class who take the biology	100	90	80	70	60	50	40	30	20	10	0
	Number of Colleges										
Freshmen	0	3	2	3	5	7	3	1	3	2	10
Sophomores	0	0	1	1	3	4	2	4	11	7	6
Juniors	0	0	1	1	2	1	2	1	5	15	11
Seniors	0	0	0	0	0	0	1	3	2	12	21
Freshmen and Sophomores	4	6	10	6	5	0	2	0	2	1	3
Juniors and Seniors	2	1	1	1	0	1	3	8	10	6	6

It is perfectly clear that so far as these colleges are concerned the great majority, *i. e.*, 30 to 100 per cent., of the classes in introductory biology are freshmen and sophomores, and that 0 to 30 per cent. are from the junior and senior classes. The presumption, of course, is that the course is adapted to the needs of the lower class men and not to advanced or university students.

DATA CONCERNING THE SUBJECT MATTER OF
THE COURSE

1. The nature of the introductory course in the different colleges is given in the following tables.

Invertebrate zoology in 3 colleges.
Vertebrate zoology in 0 college.
Zoology (vertebrate and invertebrate) in 23 colleges.
Animal and plant (biology) in 16 colleges.
Botany in 2 colleges.

In a few colleges the student is permitted to choose between a year's course either in zoology or in botany.

2. The character of the course is to some extent indicated by the kind and number of "types" used. The returns show that the *one type course*, somewhat like Huxley's crayfish, is not used in any college; the *few type course*, like the Sedgwick and Wilson biology, is used in 11 colleges; the *many type course*, like the Parker and Haswell zoology, is used in 28 colleges. A distinct modification of the last kind of course consists in greatly empha-

sizing one, usually a vertebrate organism, and studying other types in less detail, and fewer in number. Seven colleges adopted this kind of course.

The following table gives an idea of the number of types used in different colleges.

ZOOLOGY COURSE

Number of Types	Number of Colleges
15	2
14	1
13	0
12	5
11	5
10	9
9	5
8	5
7	2
6	4
5	1

Total 23 colleges

PLANT AND ANIMAL COURSE

Number of Animal Types	Number of Plant Types	Number of Colleges	Total Number of Types
10	4	1	14
8	4	1	12
9	3	1	
7	5	1	
7	4	2	11
7	3	1	10
6	4	1	
5	5	3	
8	1	1	9
5	4	1	
3	6	1	
3	4	1	7
2	4	1	6

Total 16 colleges

These tables clearly show the preponderance of the zoologist and of zoological types, even in so-called biology courses. They also indicate the significant departure from the study of a representative type from each phylum, in the direction of limiting the number except in courses mistakenly designed to prepare students for medicine.

In the following table the zoologic types are grouped according to their frequency:

	Colleges
Protozoan type used in	38
Cœlenterate	37
Annelid	36
Crustacea	33
Amphibia	31
Insecta	25
Mollusc	22
Echinoderm	19
Flat worm	16
Fish	13
Sponge	12
Mammal	11
Embryology	8
Round worm	4
Bird	3
Reptile	3
Man	1

This table also shows that there is a distinct tendency not to include in the course a type from each phylum. It is far more significant as indicating the choice of types that are believed to have the greatest teaching value, as judged by teachers in different colleges. The first half of the table includes the types that will probably be chosen more and more for the kind of course under discussion.

When the botanical types are grouped according to their frequency in the sixteen colleges, it is found that the

Fern is used in 13 colleges,
Yeast in 11 colleges,
Algæ in 11 colleges,
Flowering plants in 9 colleges,
Fungi in 8 colleges,
One-celled plants other than the above in 3 colleges,
Fern and lower plants only in 5 colleges.

This table shows that plant phenomena are taught in most of the colleges from representatives of all the main plant groups, namely, bacteria, algæ, fungi, ferns and flowering plants, that economically important plants are given splendid recognition. This distribution of types stands in marked contrast to the zoologic courses in which invertebrate types predominate.

It may be interesting to note that only seventeen colleges used the well-known ascending or evolutionary order in the study of the

types, three colleges used the descending or so-called pedagogic order, *i. e.*, from organisms best known to the student to those least known, or those whose study involves the greatest technical difficulties. In fourteen colleges an introductory type is studied intensively to acquaint the student with biologic apparatus and methods, and to afford a basis for comparison with subsequent types. The ascending order in most colleges follows this introductory type. In four colleges only the type method of instruction is not used at all, as splendidly illustrated in Needham's book.

TIME IN HOURS DEVOTED TO THE COURSE

There is an extremely wide range in time and in the distribution of the time to lecture, recitation, laboratory and field work. The following tables give the detailed information.

FOR ONE YEAR	
Hours per Week	Number of Colleges
11	1
10	3
9	1
8	1
7	4
6	10
5	7
4	6
FOR ONE HALF YEAR	
8	1
5	1
4	1
3	2

Far more significant than the mere fact that most colleges provide four to six hours per week for one year, which arrangement seems to be the one more and more in vogue, are the facts shown in the next table, which gives the time devoted to lecture, recitation and laboratory.

Hours per week	0	*	$\frac{1}{2}$	1	2	3	4	5	6	7	8	9
To lecture	0	2	3	13	19	4	0	0	0	0	0	0
To recitations	9	7	4	18	2	0	1	0	0	0	0	0
To laboratory	0	0	0	0	13	10	8	2	4	0	3	1

* Occasional.

It will be observed that in several colleges as much time is given to lecturing about things as to the study of the things them-

selves. In eighteen colleges two hours a week are spent in lectures and two hours a week in the laboratory; in three colleges three hours are devoted to lectures and the same time to laboratory. This is a regrettable survival of the so-called German university system.

In four colleges no recitation or quiz is given at all. In thirteen only an occasional recitation is held; in three colleges not more than a half hour, either each week or at various intervals, but not extending beyond this time.

The following table supplements the above and brings out in sharp relief the over-emphasis of the lecture and the very inadequate attention to the recitation.

Lecture	Number of Hours in		Number of Colleges
	Recitation	Laboratory	
1	1	2	2
$\frac{1}{2}$	$\frac{1}{2}$	2	2
1	1	3	2
1	1	4	5
1	1	5	1
1	1	6	2
1	2	8	1
2	0	2 $\frac{1}{2}$	5
2	*	3	4
2	1	2	2
2	0	4	1
2	1	4	2
2-3	0-1	5-9	1
2	0	6	1
2	0	8	1
2	1	8	1
3	0	3	1
3	$\frac{1}{2}$	3	2
3	1	6	1
3	3	2	2
$\frac{1}{2}$	2	5	1
few	4	3	1

* Occasional.

The following table gives an idea of the frequency that certain topics are considered in the course, either in the laboratory lecture, essays or assigned readings.

32 colleges, the theory of evolution.

31 colleges, heredity.

29 colleges, comparative anatomy of invertebrates.

24 colleges, comparative anatomy of vertebrates.

22 colleges, histology.

21 colleges, bacteriology and sanitation.

19 colleges, botany.

15 colleges, experimental zoology.

15 colleges, experimental embryology.

13 colleges, paleontology.

There are twenty-five colleges that treat of the economic or applied biology, eighteen of which treat this phase of the course in lectures only, four in lectures and laboratory, three in lectures, laboratory and practical or field work. Four colleges do not include economic aspects of the science in the course.

I had hoped to obtain information with reference to the manner and the extent to which this aspect of the problem was considered. But the returns did not lend themselves to tabulation.

ARTICULATION WITH SECONDARY SCHOOL BIOLOGY

In the College of the City of New York the students in the introductory course include those who have not had a high-school course in biology and those who have had such a course. It has been our experience that the one group is not appreciably better informed or better equipped to attack the subject, nor do they appear to do any better than the other group of students. It is not my purpose to make any reflection upon the excellent work done by exceedingly able and conscientious teachers in the high schools. I merely wish to state that, so far as our experience goes, it is altogether probable that the college course may safely ignore any training or equipment based upon the high-school course in biology. Furthermore, since every tendency indicates a continued independence of the high-school courses from the domination or educational policies of colleges and universities, it seems safe to conclude that any articulation with the high schools is inadvisable.

BIOLOGY TEACHING IN COLLEGES

It is now generally agreed that every college man or woman should have had at least one year's college biology. This plan is now adopted in nearly all colleges. It is also agreed that in order to reach the larger body of students and to make possible later special-

ization that the introductory course should be offered as early in the college curriculum as possible.

Since an exceedingly small proportion of the students continue the study of biology, namely, those preparing for medicine or teaching, and since the great majority leave college without any further training or acquaintance with the subject, the opinion seems to prevail that the introductory course should be a rounded one, that it should give a first-hand acquaintance with *living organisms*, in relation to their environment, an adequate idea of the larger and fundamental problems of the biologist and, above all, an idea of the general methods used in biologic investigations.

While there is considerable range of opinion with respect to the time required for the course, there is an undoubted tendency to limit the course to five or six hours a week for one academic year.

Upon the broad lines just suggested there is a general agreement, beyond these there is a healthy divergence of opinion, particularly upon the nature and the content of the course. There has been an undoubted tendency away from the narrow study of comparative morphology, the standard course of a generation ago, toward an increasing emphasis upon an adequate understanding of fundamental biologic phenomena, as we understand the term to-day, of the unit of the organism, the cell, the organism, and the fundamental processes characteristic of living things in general. To give such a course it has been found increasingly expedient to study representatives of animal and plant kingdoms. There are very many eminent teachers who believe that, on account of practical difficulties, it were better to use animal organisms only and to develop the fundamental properties of living things from zoologic types only. But these teachers are in nearly every instance zoologists.

The chief kinds of courses show considerable variation. There are courses like the almost abandoned narrow comparative morphology, others in which attention is directed to the functioning of the mechanisms

studied and others in which the emphasis is placed upon the laws which living things obey, and only sufficient attention given to the structures involved as will make the understanding of these laws possible. Professor Kofoed's course, as I understand it, is one such course. This idea carried to its extreme is illustrated in courses that follow more or less closely the Jordan and Kellogg evolution book. Where the endeavor is to offer an abbreviated course usually covering one semester and to give the student an idea of fundamental principles a course somewhat along the lines of Sedgwick and Wilson's biology is followed. Professor Needham's course in biology is too well known to need extended comment. It is another fine contribution and merits further trial.

There can be no question but that the trend of thought is in the direction of giving the student a rounded and definite view of the world of living things, that the student who pursues the subject no further may carry with him an adequate knowledge of the world of living beings, and that the student who intends to make a more intensive study of the biologic sciences may have a sufficient background for the choice of his electives as his interest or needs may demand.

With a changed viewpoint in the matter of the scope of the course has come an increasing appreciation of the value of the study of *living things*. They are no longer thought unworthy of serious study, to be left to teachers of kindergartens and elementary schools. It is no longer deemed necessary to depend exclusively upon foul-smelling, often distorted and discolored preserved specimens for an understanding of a living organism. At the last meeting of the representatives of the colleges of the Middle States and Maryland there was a wholesome and surprising agreement on the important place that living organisms should hold in our biologic courses.

With an appreciation of the desirability of studying living organisms the importance of local or well-known forms has become apparent. The choice of a type has unfortunately been too frequently determined by the

author of the laboratory guide book, rather than the needs of the student. Where there is a choice between two forms that are equally good in developing the ideas of structure or physiological processes, the local or more generally known form should always be preferred. Obvious as this may appear, there are a number of instances where exotic or marine forms are used where fresh-water local specimens are available.

The data submitted showed that there was a very wide range in the time given to the course, that there was nevertheless a tendency to limit the number of hours to five or six a week for one year. Whatever the number of hours may be, there is, in so many colleges, an undue importance placed upon the value of lectures as against the value of self-expression either in the laboratory or in the recitation. If our message is to study nature, not books, even if it appears necessary to study nature through the artificial medium of the laboratory, as much time should be given to the study of organisms at first hand as circumstances warrant. It is exceedingly difficult to state what proportion of the time should be spent in the lecture, laboratory and recitation. It is easier to state what is wrong than what is right. It seems to the writer at least that two hours in the lecture room and two hours in the laboratory placed a disproportionate emphasis upon a knowledge about, rather than of, nature. Yet in twelve colleges this is the situation.

Even more surprising is the lack of appreciation of the value of the recitation in such an introductory course. In nine colleges, for example, no opportunity is offered for self-expression on the part of the student, or for determining how far the student has grasped the ideas, or to what extent the course is adapted to the needs of the particular group of students, but more important even than these is the opportunity offered by the properly conducted recitation to let the student appreciate the method of scientific thinking and the numberless unanswered problems that the biologist is wrestling with. In seven colleges only occasional recitations are held; in

four colleges the recitations extend not more than a half hour a week.

It is to be hoped that the reserve that has so long prompted many excellent teachers and biologists to withhold from their colleagues the results of their many years of experimentation and thought upon the teaching of introductory biology, may be set aside and that appropriate means be found for an exchange of experiences. If arousing and developing a wholesome interest in biology is an important part of our duties in the colleges or universities, should we not cooperate in aiding one another in this important work. At worst, we can agree to differ.

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MEXICAN ARCHEOLOGY AND ETHNOLOGY

A GREATER impetus will be given to the International School of American Archeology and Ethnology in the city of Mexico in this, the fourth year of its existence. The members have been added to and the fund for its use will be increased so as to permit of larger activities and explorations. The school was founded in 1910 by the governments of Mexico and Prussia, Columbia University, Harvard University, the University of Pennsylvania and the Hispano Society of America, under the initiative of Columbia. In the second year of the school the government of Russia, through the Imperial Academy of Sciences, and the government of Bavaria, joined the school, and in the third year the government of Austria and the city of Leipzig, through its ethnological museum, joined it. During the first year the budget of the school, including salaries and fellowships, amounted to \$6,000, in the second and third years to \$10,000 each, and in the coming year it will be \$12,000, of which amount Mexico contributes \$3,000 and two \$500 fellowships. No elementary or popular instruction is given in the school, but opportunity is offered to advanced students to familiarize themselves with the problems of Mexican archeology and ethnology, and to understand researches in these fields. The objects collected by the school are