

DETERMINATION OF OBJECTIVES IN BIOLOGY TEACHING, PAST AND PRESENT*

THIS paper is a report of an investigation made to determine the relative agreement or disagreement among textbook writers and others as to the objectives in biology teaching in high schools, and to determine those which tend to be most desired at this time. For this work the prefaces, introductions and first chap-

ters of forty texts were used, also treatises on secondary education which discuss objects of biology teaching and committee reports. The texts used included twenty biology, ten botany, and ten zoölogy, publishing dates ranging from 1896 to 1920, inclusive. There is also a brief comparison made between objectives previous to 1900 and those held since 1900. The following is a list of the books used, arranged in order of publication.

BIOLOGY TEXTBOOKS

<i>Author</i>	<i>Text</i>	<i>Publishers</i>	<i>Date of Publication</i>
Hunter	Elements of Biology.....	American Book Co.	1907
Conn	Biology	Silver, Burdett Co.	1918
Peabody and Hunt.....	Elementary Biology	Macmillan	1913
Hunter	A Civic Biology.....	American Book Co.	1914
Hodge and Dawson.....	Civic Biology	Ginn	1918
Gruenberg	Elementary Biology	Ginn	1919
Smallwood, Reveley, and Bailey	Biology for High School.....	Allyn and Bacon.....	1920
Moon	Biology for Beginners.....	Henry Holt	1921
Atwood	Civic and Economic Biology.....	Blakiston's Sons	1922
Hunter	New Essentials of Biology.....	American Book Co.	1923
Trafton	Biology of Home and Community.....	Macmillan	1923
Clement	Living Things—An Elementary Biology	Iroquois Publ. Co.	1924
Peabody and Hunt.....	Biology and Human Welfare.....	Macmillan	1924
Gruenberg	Biology and Human Life.....	Ginn	1925
Hunter	New Civic Biology.....	American Book Co.	1926
Kinsey	An Introduction to Biology.....	Lippincott	1926
Moon	Biology for Beginners.....	Henry Holt	1926
Atwood	Biology	Blakiston's Sons	1927
Menge	The Laws of Living Things.....	Bruce Publishing Co.	1927
Weldon	Economic Biology	McGraw Hill	1929

BOTANY TEXTS

<i>Author</i>	<i>Text</i>	<i>Publishers</i>	<i>Date of Publication</i>
Bergen	Elements of Botany.....	Ginn	1896
Barnes	Plant Life	Henry Holt	1898
Bergen	Foundation of Botany.....	Ginn	1900
Coulter	Plant Studies	Appleton	1902
Bergen and Caldwell.....	Practical Botany	Ginn	1911
Bailey	Botany for Secondary Schools.....	Macmillan	1913
Sergent	Plants and Their Uses.....	Holt	1913
Bergen and Caldwell.....	Introduction to Botany.....	Ginn	1914
Atkinson	Botany for High Schools, 2nd Edition (1912 revised).....	Holt	1925
Pool and Evans.....	First Course in Botany.....	Ginn	1928

ZOOLOGY TEXTS

<i>Author</i>	<i>Text</i>	<i>Publishers</i>	<i>Date of Publication</i>
Jordan and Heath.....	Animal Forms	Appleton	1902
Jordan and Kellog.....	Animal Life	Appleton	1903
Jordan, Kellog, and Heath.....	Animal Studies	Appleton	1903
Davison	Practical Zoölogy	American Book Co.	1906
Linville and Kelly.....	Zoölogy	Ginn	1906
Galloway	Elementary Zoölogy	Blakiston's Sons	1910
Daugherty	Principles of Economic Zoölogy.....	Saunders	1912
Hegner	Practical Zoölogy	Macmillan	1915

*This paper is the outcome of a problem studied in 1923 at Teachers College, Columbia University, under the supervision of Dr. S. R. Powers.

Kellogg and Doane.....	Economic Zoölogy and Entomology	Holt	1915
Linville, Kelly, and Van Cleave	General Zoölogy	Ginn	1929

The other publications used and dates of publication are as follows:

<i>Author</i>	<i>Text</i>	<i>Publishers</i>	<i>Date of Publication</i>
Snedden	Problems of Secondary Education	Houghton Mifflin Co.	1917
Inglis	Principles of Secondary Education	Houghton Mifflin Co.	1918
Bureau of Education.....	Cardinal Principles	Bureau of Education	1918
Bureau of Education.....	Reorganization of Science.....	Bureau of Education	1921
Stout	The Development of High School Curricula in the North Central States from 1860-1918.....	University of Chicago	1921
Finley	Biology in Secondary Schools and the Training of High school Teachers	Bureau of Publications, Teachers College	1926

The prefaces, introductions and first chapters of the texts were read and the authors noted on cards (3 in. x 3 in.), each card bearing the objectives stated by the author or authors in one book only. When

this was completed the various objectives of all authors were classified, and the frequency of recurrence noted as shown in the accompanying table.

TABLE SHOWING FREQUENCY OF RECURRENCE OF OBJECTIVES IN VARIOUS TEXTBOOKS

<i>Objectives</i>	<i>Biology 20</i>	<i>Botany 10</i>	<i>Zoölogy 10</i>	<i>Total 40</i>
Interpretation of Biological, Botanical and Zoölogical Phenomena	18	8	7	33
Ecological	16	7	7	30
Economic	12	5	5	22
Disciplinary	10	6	6	22
Morphological	4	8	6	18
Physiological	10	6	2	18
Health	13	1	3	17
Coöperation for common good (Adjustment to life relations).....	11	2	2	15
Sociologic	13	..	..	13
Classification	3	4	5	12
Enjoyment—Interest for leisure time.....	5	4	2	11
Domestication and improvement of plants and animals	7	2	..	9
To correlate study of botany, zoölogy and human physiology and relation to other subjects.....	8	..	1	9
Preparatory	6	1	2	9
Laboratory and Field Work.....	Not determined	3	5	8
Conservation	6	..	..	6
Informational .....	..	4	1	5
Habits and Life History of Animals.....	..	..	4	4
Vocational	3	..	..	3
To exhibit variety and progressive complexity.....	..	3	..	3
To understand struggle for existence.....	..	3	..	3
To present elementary phenomena (physics and chemistry) needed for physiological work in biology..	1	..	..	1
To make pupils acquainted with important works on zoölogy .....	..	..	1	1
Psychological .....	..	..	1	1

By studying the table we find that eighteen of the twenty biology texts include, as an objective, ability to interpret biological phenomena. Eight of the ten botany and seven of the ten zoölogy texts also include this objective. This makes a total of thirty-three of the forty texts used. The ecological aspect (study of plants and animals, including man, as related to their environment) is mentioned in sixteen biology, seven botany and seven zoölogy texts—a total of thirty books. The economic phase is stated as an objective by twenty-three authors, twelve in biology, five in botany and six in zoölogy. The disciplinary aspect is mentioned by twenty-two authors, and the morphological and physiological by eighteen. The health aspect is mentioned by seventeen authors. The others as shown are mentioned by less than seventeen of the authors. From the foregoing we learn that the only objectives at all commonly stated by these authors of textbooks in their prefaces, introductions and first chapters are (1) ability to interpret biological phenomena and (2) knowledge of plants and animals as related to their environment. The other five objectives given above are mentioned by approximately half of the authors. We note, therefore, comparatively little agreement among authors in this study of objectives.

In order to determine the tendency in aims in biological teaching, we shall first consider those objectives or points of view determined by Stout and others for the period previous to 1900, then those for the period 1900 and after. Stout found that there were three aims clearly shown; first, the religious aim, still in evidence in 1860. Though not very important, references were made to this in prefaces of texts up to the close of the century. The second aim is that for knowledge. This includes two points of view. One "emphasized the value of knowledge—truth for truth's sake—to the end that the learner may be regarded

as an intelligent person." The other "emphasized the importance of science from the standpoint of practical utility as distinguished from a knowledge which merely contributed to one's general intelligence." The third and controlling aim, especially during the latter part of the period, was that of mental discipline. He divided the study of botany and zoölogy into four periods. For botany there are (1) previous to 1860 emphasis placed on premedical training and religious aim—the latter as has been mentioned persisting somewhat throughout the century; (2) emphasis almost entirely upon anatomical structure with the aim to train students in the technique of analyzing and classifying flowers and plants; (3) emphasis placed upon morphology of plants with the aim to train "into scientific habit of mind" (mental discipline); (4) emphasis placed on practical value. This is shown in Bergen and Caldwell's book. The change became noticeable among authors of textbooks only after 1910. In Finley's monograph we find practically the same aims mentioned for the study of botany as in Stout's publication. With reference to the last period, it is interesting to note that Dr. Finley says, "Teaching botanists of the day began to question the disciplinary value of the systematic morphological botany. Plant ecology, plant physiology and economic relations were stressed in science associations and in the written articles of the period." To illustrate the change of thought, he quotes from an article in *School Science and Mathematics*, May, 1901, by A. M. Ferguson, as follows:

"Botany does not mean the 'analysis and naming of flowers' nor pressing specimens and calling it an 'herbarium.' Botany concerns plants, how they grow and are grown, when and where they came from, their habits and peculiarities, and the relation they bear to the general economy of nature."

Dr. Finley then makes the following com-

ment. "The kind of botanical instruction advocated in these quotations is that which is receiving emphasis at the present time." Furthermore, we note in our study that the economic aspect is decidedly stressed by the more recent botany authors.

For zoölogy the four periods are as follows: (1) characterized by the formal aspect of the subject. Though this period emphasized classification, it included natural history. The zoölogists of the period "were interested more in certain traits which animals and men possess in common than in anatomy and morphology" (Finley). Dr. Finley again quotes (This is from Tenney, Sandborn and Tenney, *Natural History of Animals*, 1871):

"'Animals are most interesting objects of study, and the child as well as the man is delighted with learning their forms, structure, color, habits, and names and soon becomes as eager as a naturalist to find a new Bird or a new Butterfly.'" During this early period the religious aim was also stressed. The following from Agassiz and Gould, *Principles of Zoölogy*, 1848, expresses it.

"'Should our aim be attained, this work will produce more enlarged ideas of man's relations to Nature, and more exalted conceptions of the Plan of Creation and its great Creator.'" (Finley.)

(2) characterized by comparative anatomy—anatomical structures and classification of animals receiving most attention and the religious aim still in evidence.

(3) anatomical structure still remained the basis of work, but the morphological point of view was emphasized—much stress placed upon lower forms of life and laboratory work introduced (no "innocent and virtuous amusement" offered by these books nor opportunity to "occupy agreeably the leisure or vacant hours of life").

(4) marked by the attempt to combine the earlier natural history type of material with the more formal anatomical and mor-

phological type. Field work was combined with laboratory work and emphasis was placed upon the functional aspect of animal life.

Inglis gives three periods in the development of study of the natural sciences in secondary schools.

(1) 1800-1870—sciences studied largely as informational courses.

(2) 1870-1900—marked by tendency to organize the study of natural sciences according to the demands of pure science.

(3) 1900—characterized by attempts to organize the study of natural science in part according to their applications.

Thus we see that changes in subject matter previous to 1900 were due to professional influence—the shift of influence and point of view of teachers of science. Though the aim of high school was to prepare for life as well as for college, and the former purpose was mentioned in many prefaces previous to 1900, the texts gave little material which could claim to do this. Subject matter was treated in an extremely formal style, which resulted in great dissatisfaction with science teaching. After 1900 (more marked after 1910) we find that aims of authors are influenced by the practical value of their subject.

Let us compare the foregoing with the textbooks studied. We note the following facts. Thirty of these books were published in 1910 or later. Twenty-two, or slightly more than half of all considered, mention the economic aim. These include only two books published previous to 1910. The disciplinary aim, mentioned in twenty-two, the physiological in eighteen, classification in twelve, and laboratory and field work in eight are well distributed over the whole period studied (1896-1929). Eighteen, or approximately half of the books considered, mention as an aim the study of morphology. Among these, however, only four were published after 1915. The health aim mentioned in seventeen, correlation of botany,

zoölogy and human physiology in nine and preparatory in nine are each noted in only one book published previous to 1910. Adjustment to life relations (coöperation for common good) noted in fifteen, the sociological in thirteen, enjoyment (worthy use of leisure) in eleven, domestication and improvement of plants and animals in nine, and conservation in six were not mentioned before 1910. The vocational aim is included on three (1919, 1921, 1929). Here we also find the tendency toward aims which are practical and aims which are influenced by the industrial world. And in the objectives noted in *Cardinal Principles of Secondary Education* and in *Reorganization of Science in Secondary Schools* we find a similar course.

Cardinal Principles include these seven aims—(1) Health, (2) Command of fundamental processes, (3) Value of home membership, (4) Vocation, (5) Good citizenship, (6) Worthy use of leisure, (7) Ethical character.

Snedden gives the following as his objectives, the first two being of greatest importance.

(1) to give boys and girls an outlook upon the world, as interpreted through biological sciences, which as a part of general culture will be demonstrably worthwhile.

(2) to give to all persons, who must stand in the utilizing or consuming relationship to life, a varied and full appreciation of the applications of biological knowledge to the enormous range of productive activities as to the products of which each one of us stands in an important relation as consumer (to train pupils to be consumers in the scientific sense—make demands for pure food, remedial measures in medicines, etc.).

(3) have biological science contribute to an enlargement of the pupil's comprehension of modern life by an intellectual consideration, through all forms of popular literature, of modern development in agri-

culture, medicine, forestry, fisheries, etc., based upon this knowledge.

(4) to give the pupil an appreciation of the meaning of scientific method as applied in the world of pure science as well as practical affairs, and more particularly as such method applies in biological science, where such instruments of precision as the microscope, means for breeding of bacteria, etc., can be considered.

(5) to apply biological science to such fields of human activity as the breeding of useful animals, the elimination or reduction of animal life injurious to human beings, and in conservation of human health.

(6) to have a useful and valuable appreciative attitude towards the work of specialists, and to be able to put a premium upon that work which is done by persons most completely equipped for their work.

(7) to study biology for cultural or general purposes.

(1) may be said to include or correspond to interpretation of biological phenomena in our table. (2) may be said to include our health aim, adjustment to life relations, conservation, domestication and improvement of plants and animals. (3) may include interpretation of biological phenomena. One author only, however, speaks of making pupils acquainted with the important works of zoölogical information (1906). (4) may include the disciplinary, laboratory and field work and preparatory aspects. (5) also includes several of our aims, while (6) is not mentioned by any author. (7) may be included in the informational objective.

Bobbitt's objectives are summarized in the following outline:

1. Ability to perform the several processes involved in the effective development and maintenance of one's physical efficiency.

2. The unspecialized abilities involved in the care of plants about one's premises.

3. The unspecialized abilities involved in the care of poultry, bees, live-stock, pets,

etc. (Of less general serviceability and therefore appropriate to only a portion of the pupils.)

4. Ability, disposition and habit of observation of significant biological phenomena as an enjoyable and fruitful leisure occupation.

5. Ability, disposition and habit of reading relative to biological matters as an enjoyable and fruitful indirect method of viewing biological phenomena; also a leisure occupation.

6. A proportioned vision (according to one's intellectual capacity) of the biological world as a whole—plant and animal series—as it exists today and in its genesis.

7. Ability wisely to control the several biological factors—so far as control is possible or desirable—involved in the responsibilities of parenthood.

8. Ability, disposition, and habit of viewing Man in world-genesis and relation—as a major foundation of one's sense of human brotherhood, and as one of the most inspiring visions of one's religion.

Bobbitt does not include in his objectives the aim to teach children the importance of conservation and domestication and improvement of domesticated animals and plants, except if we consider his second and third aims in a very broad sense. He does not include the vocational nor the preparatory, but does make mention of the religious aim.

By a study of our table on textbooks as given above we find that though there is comparatively little agreement among textbook authors as shown by their prefaces, yet there is the tendency toward emphasis by the more recent writers (1910 and after) on the following objectives:—Understanding of economic relations between plants and animals and man, health, adjustment to life relations, conservation, domestication and improvement of plants and animals, sociological, worthy use of leisure, and vocational. Checking this list with those aims

given in *Cardinal Principles* we find the following common to both:—Health, worthy use of leisure, worthy home membership, good citizenship, and vocational. (Very recent.) Bobbitt, Inglis and Snedden do not include the vocational. On the whole, however, we find that the aim is to make material practical, of use to the individual to make him a better citizen.

"The purpose of democracy is so to organize society that each member may develop his personality, primarily through activities designed for the well-being of his fellow members and of society as a whole."

BERTHA WITTLINGER

PRESENT CLIMATE NOT CHANGING

IF THE word "climate" is first defined, the likelihood of any misunderstanding from the title is somewhat reduced. In Maury-Simonds' *Physical Geography* (1908), page 210, statements are found which say that climate includes "an aggregate of weather conditions" based upon observations extending over a series of years. The discussion of the statement indicates that the longer the period of observation, the more valuable become the data upon which climate is established. More recent publications give the same idea in defining and discussing climate.

As it is so often remarked in conversations that climate is changing, it is well to notice this popular idea in its conflict with the observations of those who make a scientific study of climate. The popular idea of climate changing is based upon memory and the "feelings" type of observations. Memory is inclined to recall the exceptional years or climatic conditions which were outstanding because they were unusual. In contrast, the climatologist bases his decision on the records which have been preserved from daily observation of standardized instruments.

The climatologist carefully distinguishes