CHANGE IS THE PRICE OF PROGRESS

The Mastodon didn't adapt himself to change and he exists only in museums.

A STUDY IN SYSTEMATIZING THE SOCIAL IMPLICATIONS OF BIOLOGY

A THESIS

SUBMITTED TO THE DEPARTMENT OF EDUCATION AND THE GRADUATE COUNCIL OF THE KANSAS STATE TEACHERS COLLEGE OF EMPORIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

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To

My Mother

Whose sensitive spirit
Taught me to appreciate beauty
Study birds and love nature

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CHAPTER I

HISTORICAL INTRODUCTION

Primitive man gained his knowledge of what is now called biology by means of his intimate contact with ruthless natural laws. When and how he came to think upon life and its relationships is purely conjecture, but that he did have many illogical, important, ideas about his environment is a point in which historians are entirely in agreement. In his poor, stupid way, the primitive ancestors of mankind laid the necessary foundation for civilization. Life, death, health, sickness, growth, food, emotion, and homicide were all within the common experience of the early human race. The inability to fathom the mysteries of life made it necessary that superstition be called upon to explain that which is now common knowledge. The important thing was, however, that these things attracted his attention, without which there would never have been the long, unending series of investigations that has lead us to our present knowledge of the phenomena of life.

Within the reach of written history can be found the views of such men as Democritus, Hippocrates, and Aristotle--the first evolutionist. Biology as a separate subject-matter unit is a recent addition to the great fields of science that have fired men's enthusiasm, but it has been an important part of all the generalized science since the time of Comenius.[1]

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[1] Johann Amos Komensky, 1593-1670.

His view on education was, "setting forth the whole art of teaching all things to all men...that the entire Youth of both sexes, none being excepted, shall quickly, pleasantly, and thoroughly become learned in the Sciences..."[2]

Sir Humphrey Gilbert, a contemporary of Comenius, proposed for the English academies a course of instruction including natural philosophy and physics.

A long line of European leaders have vitally affected the trend in educational philosophy in Europe and America. John Calvin (1509-1564), although he never forsaw it, is considered to be the father of the public schools. During the seventeenth and eighteenth centuries, Locke, Rousseau, Pestalozzi, and Herbart were the great contributors toward making education what it is today. It was not until the nineteenth century, however, that science was introduced into education as an ideal scheme of training for complete living. Perhaps no one man is more responsible for the movement of putting science into the schools than Herbert Spencer, an Englishman, who may be rightfully regarded as the philosopher of the scientific movement during the latter half of the nineteenth century. He contended that science is the ideal educational subject for the schools because of its utility. Utility is a strong defense for any subject. Any subject that remains in the schools and stands the test of time, must sooner or later have the measuring stick of utility applied to it.

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[2] Johann Amos Comenius, The Great Didactic, translation by M. W. Keating (Adams and Charles Black, London, 1896), p. 154.

CHAPTER II

THE GENERAL NATURE OF BIOLOGY

The position is commonly taken by the zealots in any branch of science that their subject is a veritable matrix, around which the whole range of related subjects should be built. With this idea in mind there is a constant rivalry between the closely related sciences for leadership and dominance of science in general. Much of the rightful subject matter in any field is necessarily taught under the heading of a rival science. This is not a condition to be deplored, but rather a fine means of integrating the curriculum. However, the proponents in a given field of science should recognize those inter-relationships as such and enrich this lateral correlation materially. There is a great amount of overlapping by this procedure which will tend to tear down the subject matter lines that have so long menaced the perspective of educational objectives.

Rather than to consider each compartment as though it were in competition with all related subject matter compartments and therefore bound to justify its existence as a separate and distinct entity, why not recognize the relationships and consider the common fundamental objectives as the ends worthy of their existence? The demands of specialization and the pride in same have conspired to make men seek to label themselves with no other good reason for so doing. To be a good chemist, one must at the same time know something of physics and visa versa. To be a good biologist one must at the same time be somewhat of a physicist and chemist. These

inter-relationships in the sciences are obviously legion. The tendency has been for each science to establish itself as the central core around which all the other sciences are clustered as subordinates or contributors. Peculiar as it may seem this can be done with any of the exact or applied sciences from math to sociology. It is because of the inter-relationship of the whole gamut of man's knowledge that such variable classifications and evaluations are possible. It is like trying to decide which is the more important part of a home, the father, the mother, the child, or the house they live in. Or, it is like analysing a man; one could set up the nervous system, the digestive system, the skeletal system, or any other system, as the central core which serves and is served by all other systems.

Science in its broad application includes the sum total of man's knowledge. The names that have been applied to its branches are for convenience rather than for isolation. No single branch can sustain itself alone any more than a man's arm can exist by itself simply because it is highly organized, specialized, and adapted to a definite type of service. The hand was not made for the brain nor the brain for the hand, nor the stomach as the slave of both, but all the parts, highly organized and individually named as they are, merely make up the single organism.

Now, what shall be the approach in teaching the subject matter of a given science? How long will the fallacy of separate sciences go unchallenged? To teach them as separate, all-important entities comparable to training a child to walk by first teaching him to use his

right leg and then the use of his left. No single subject is self sufficient. There are, however, certain fundamental objectives that transcend all subject matter lines.

To illustrate with a single 'so-called' unit subject, biology could very well be done away with as a school subject. The objectives which it includes could be parcelled out to related subjects and nothing lost. Therefore the important thing about any branch of science that exists as a teaching compartment is not necessarily its unity but its utility. It is doubtful that any subject should be assigned definite objectives as a general assumption. Rather the aims of the subject should be worked out as embracing some 50 or 100 objectives. The objectives, which would duplicate those of other subjects, could be parcelled out to the subjects offered that could most readily lend themselves to the service. As in the case of the biological objectives, they could be assigned to physiology, physical education, hygiene, history, chemistry, and possibly English.

What is true for any single subject is probably true for all subjects. The definite objectives of the sum total of the constant subjects in education could be enumerated under their appropriate cardinal objectives. These necessary fundamental objectives could then be assigned to such classes, regardless of the name for same, as seem equipped to handle them. By this procedure, it is doubtful that mathematics, English, or spelling would persist as subjects, but their objectives as now conceived would be incorporated in any and all of the remaining subjects. Reading,

grammar, spelling, composition, and the like are as readily learned in geography, history, and commercial subjects as in separate courses designed for the purpose. This is especially true above the intermediate level.

There are certain fundamental principles of the branch of science called biology that should reach all children regardless of whether it is done in a biology class or through the medium of several classes. Throughout the elementary schools, the biological objectives are generally quite well covered in their nature study, physiology and hygiene, and to a greater or less degree in other subjects. In the high school, the course is usually quite general in nature and includes many desirable objectives. The colleges are perhaps the greatest offenders of all. Because of their specialized departments and subjects within departments, they often require some one or two specialized courses for the 'so-called' general cultural value that makes one well-rounded. These courses are commonly required for convenience sake rather than because of any preconceived general value. If any course in the department is to be required, it should be a generalized course that will do what it is intended to do--rather than a specialized course which presupposes general knowledge. The same introductory courses are commonly required of those students planning to specialize in the department as of those subjected to it to round out their academic training.

CHAPTER III

BIOLOGY IN ITS PRESENT SETTING

The enthusiastic teacher of biological science can scarcely find time enough in a school year to present all that is felt to constitute the course. The subject of biology is so comprehensive, so voluminous, so full of omnipresent problems that it is difficult to refrain from spending time out of all proportion to its importance upon some phase of the subject which catches the fancy of the class or more commonly of the teacher. Again, the teacher may attempt to cover the whole range of the subject and thus make it so sketchy that no worthwhile, permanent impressions are left with the pupil. This viewpoint is well presented by Professor E. R. Downing of the University of Chicago when he says:[1]

> Indeed the wealth of opportunity is frequently the undoing of the high school course in biology. Both textbook and teacher undertake so much that nothing is thoroughly done. It would be wise for the teacher to select a very few specific things to accomplish. These should include certain principles of biology, of maximum social value, certain interests and appreciative attitudes of mind that need to be established, certain habits of thought. Tests should be devised and applied to make sure that these few things have been thoroughly accomplished.

It is for the purpose of outlining the limits upon the course that this treatise is presented. The writer hopes that the objectives as presented in the text will serve as entering wedges into the socially

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[1] L. W. Webb and others, Editor, High School Curriculum Reorganization (The North Central Association of Colleges and Secondary Schools, Ann Arbor, Michigan, 1933), p. 228.

significant phases of biology which should in some measure be presented to all pupils. This is not an attempt to standardize the subject, however. Biology has probably progressed best as an important contributing subject since it has not been standardized because of college entrance requirements.* The Committee of Ten in their famous report of the conferences held in December, 1892, made no mention of biology as an academic unit for study. They did include natural history which is the parent subject. This subject dealt mainly with morphology, classification, physiology and hygiene. The following are typical resolutions to be found in the report of the committee on natural history:[2]

> Resolved, That it is the judgment of the Conference that while the principles of hygiene should be included in the work of the lower grades, the study of physiology as a science may best be pursued in the later years of the high school course. We recommend that in the high school a daily period, for one half year, be devoted to the study of anatomy, physiology and hygiene, with as large an amount of practical work as is possible.
>
> Resolved, That a minimum of one year's study of natural history should be required in every course in the high school, and that at least three fifths of the time should be employed in laboratory work.
>
> Resolved, That the general comparative morphology of plants and animals be recommended as the part of natural history most suitable for study in the secondary and lower schools; that in the primary and grammar grades there should be a study of gross anatomy, and in the secondary schools a study of minute anatomy.

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* See Table III in appendix.

[2] Report of the Committee of Ten (Government Printing Office, Washington, D. C., 1893), pp. 138-61.

> Note.--The study of botany and zoology should include a general view of the plant and animal kingdoms. Limiting the study of botany to flowering plants and of zoology to two or three sub-kingdoms of animals, gives the learner imperfect and distorted ideas. The plants and animals selected for study should be typical forms, or types, and at the same time, when possible, forms familiar to the students, or common in their vicinity. In the lower grades the work should be a study of living forms, of the plant growing and of the animal in action. Here the steps should be (1) life and function, (2) structure, (3) comparison. Mere analysis or identification is believed to be of very little value. Too many scientific or technical terms should be avoided. No text-book should be used below the high school.
>
> The work in the high school should be a study of minute anatomy and classification.
>
> Throughout all the work the aim should be to make the observations and notes of the pupils systematic, clear and exact. Careful drawings should be insisted upon from the beginning. If effort is made to have the pupils obtain clear and exact ideas, and to express them clearly and exactly in words or by drawings, the study will be successful as a department of science, and at the same time, valuable and efficient as an aid in training pupils in the arts of expression.

It is obvious from the above excerps that the committee were deluded by the theory of formal discipline into giving more attention to academic details than to practical values. It is interesting to note that none of the skilled subjects such as art is reported on by the committee. No doubt, this accounts for the fact that so much emphasis is placed upon drawing as an important part of the 'so-called' natural science. This tendency has been inherited by the subject of biology to a considerable extent although the practice is extremely variable. Dr. Baird in his study of the biology notebook[3] found that the amount of credit allowed

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[3] Don C. Baird, A Study of Biology Notebook Work in New York State (Teachers College, Columbia University, New York City, 1929), p. 83.

for notebook work varies from no credit to fifty per cent of the student's grade.

The inclination of the progressive educator today is to discount the value of formal discipline and to strive toward intellectual training in preparing pupils to behave wisely in a given social setting. As Dr. Demiashkevich states,[4] "Educational psychology has shown that transfer of learning is possible with regard to information only in the case of a situation similar wholly or in part to that under which the learning was acquired."

The committee attempted to make the subject matter that has been mostly absorbed by biology a standardized college entrance requirement.[5]

> Resolved, That the year's work in natural history, as outlined for the high school, should be required for entrance to college in every course; that the examination should be both a written test and a laboratory test, and that the laboratory note books, covering the year's work, certified by the teacher as original, should be required at the examination.

Despite this early recommendation and the ever increasing popularity of the subject of biology,* it is still unacceptable to a large percentage of colleges as an entrance unit. This seems to be especially true in the North Central states.# The colleges that do accept biology as an entrance

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[4] Michael Demiashkevich, An Introduction to the Philosophy of Education (American Book Co., New York, 1935), p. 228.

[5] Report of the Committee of Ten, Loc. Cit.

* See Table II, appendix.

\# Cf. ante, p. 8, Also see Table III, appendix.

unit seem to be rather skeptical of it as shown by the following excerpts from replies of registrars from whom information was requested.[6]

> We do not at present accept the Regents examination in Biology but we accept the College Entrance Board examination in Biology. The Biology course is approved only after a satisfactory notebook is submitted to us.
>
> It would be necessary for you to bring your notebook to get full credit for your Biology.
>
> If you plan to present for admission to ---- College your year's work in Biology by passing a ----University examination in that subject, it will be necessary for you to hand in as a part of the examination a notebook certified by your teacher.

By way of contrast, to add a touch of progressivism to these otherwise rather stultifying pronouncements, this answer from a college president is quoted.

> In keeping with the best educational thinking of the day, and as a result of careful experimentation over a period of four years, the Colorado State Teachers College has decided to admit any high school graduate who is recommended by you (High School Principals and Superintendents) who has health, character, and ability to do college work.--George Willard Frasier, President, Colorado State Teachers College.[7]

Biology and the aims of Secondary Education.

From its earliest inception, the high school movement has been an attempt to free secondary education from college entrance requirements and particular philosophies or scholastic cultures. This was the avowed purpose of the first public high school which opened in 1821 at Boston. However, these ideals were only partially carried out. Outside forces

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[6] Baird, op. cit., pp. 91-4.

[7] Loc. cit.

regimented and standardized the high school just as they had done with the Latin-grammar school and the academy.

The next important step was the appointment of the N. E. A. Commission on the Reorganization of Secondary Education in 1913. The report of this Committee gave impetus to the earlier conception in 1893, in which they stated that, "what fits for life will also fit for college if it is academic and rightly taught." This was a direct reversal of the prevailing opinion that, "what fits for college best fits for life." As a result of their efforts, in 1918 they presented the cardinal principles of secondary education which have started a complete renovation in the aims, ideals, and methods of the high school. The subject of biology has developed since this report was made. Possibly this accounts for the fact that it as no other subject seems to fit any and all of these objectives.

The Biological approach to the Cardinal Objectives of Secondary Education set in their Socially Significant Relationships. Nearly every phase of biology touches directly or indirectly some contributing element to the health of the individual. Within practically every objective, there can be made some contribution to citizenship. The connection is obvious in such topics as one's duty to quarantine observance, conservation of the natural resources, sanitation, and the worthy use of leisure time. Leisure time as a cardinal principle finds ample expression in the interests and appreciations developed in nature hobbies, gardening, photography, raising animals, and observing and reading about nature in general. These activities for the most part make for worthy home membership along with the care and preservation of foods, care of wounds, landscaping, and sanitation.

The subject matter of biology contributes directly to the preparation for several professions and occupations. It is easily seen that medicine, nursing, entomology, sanitary engineering, tree surgery, forestry, animal husbandry, and various other branches of agriculture are built squarely upon biological foundations.

Biology, too, lends itself readily to character training. Analogies can be drawn on organization and cooperation. Also the pupil's understanding, appreciation, and feeling for natural laws are widened and enriched.

CHAPTER IV

THE METHOD OF APPROACH TO THIS STUDY

This is not so much a study of methods of presentation that have been used as it is an attempt to present a systematic, logical, and useful approach to the study of the subject of biology. Perhaps, too many statistical studies have already been made of things that can be only poorly measured by any quantitative scale.

This idea is expressed by Dr. Lull:[1]

> In our many and varied attempts to psychologize education and then to appraise the results by quantitative measurements, we lack a thoroughgoing knowledge and appreciation of the stuff of which civilization is made. It may be a trite statement that, if education is to parallel civilization and finally improve the social order, the curriculum makers must, first of all, understand civilization. But the appalling fact is that even the leaders in the profession of education are lacking in this fundamental respect. For a quarter of a century the schools of education of the great universities have been turning out Ph.D.'s in Education. In the latter half of this period their training has consisted mainly in studying existing school practices, setting up so-called valid and reliable tests with which to measure the products of the existing school practices, statisticalizing school procedures, and computing medians, averages, the least possible error, etc. All of this work in scientific technique is valuable, of course, but it is as if the roof, plumbing, and fixtures of the educational edifice were being built and installed without any consideration of the foundation structure. The fundamental problems of curriculum construction, however, have recently begun to share the field with other lines of educational research.

The method of approach used in this study is not claimed to be phenomenal, but it is ingenuous. It is the method suggested by the more

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[1] H. G. Lull, Secondary Education: Orientation and Program (W. W. Norton and Company, Inc., New York, 1932), p. 175.

conservative of the progressive educators who contend that there is much that is worth saving in the established, compartmentalized subject matter of the traditional curriculum. They feel that more can be accomplished by redirecting the established curriculum than by scrapping the whole thing and resorting to the radical revolutionary methods of the ultra progressive.

The viewpoint is that the curriculum must be socialized not suddenly but by gradually working into it a logical, workable procedure. This is done by going back to the fundamental principles upon which the modern curriculum is supposedly built. Almost all will admit that the cardinal objectives of secondary education as set up by the N. E. A. in 1918 are worthy ideals. Consequently they are used as starting points in selecting the significant material for any subject. The implications and problems arising out of each objective, in so far as they are within the scope of the given subject, are then approached through the rather definite although overlapping areas, namely the community, the state, the nation, and the world. The application of these objectives in the various areas are consistently set forth in terms of initiative, sharing, co-operation and desirable social consequences.

CHAPTER V

HEALTH

I. Health activities in terms of socially significant meanings involving initiative, sharing, cooperation and desirable social consequences.

A. The community as a major area in significant social relations.

1. To understand how the various types of physical recreation may be used in developing and safeguarding good health, and how to select those types and organize them as a part of one's daily living in ways that will give the greatest enjoyment and the optimum results for health.

a. Biological hobbies, while primarily important as leisure time activities, are obviously conducive to mental and physical health. Interest in aquaria and terraria, gardening, landscaping, floraculture, the raising of birds and other pets, and the study of plant and animal life provide a most wholesome relief from the economic and social strain of everyday life.

b. An interest in and a knowledge of the habits, economic importance, and classification of the plants and animal life of the community will encourage hiking and other outdoor activities.

2. To understand the production and care of wholesome pure

foods and drinks and their uses in the best possible dietaries for individual pupils.

a. The meaning of the balanced diet as an inescapable natural law should be thoroughly understood.

b. Study the foods that are produced or manufactured in the community from the standpoint of:

1) Nutrition

2) Sources of contamination

3) Precautions taken to prevent contamination

4) Methods of storing, transporting, handling, and preserving

5) Methods of determining the presence of harmful bacteria

3. To understand the relationship of the plant and animal life of the community to accidents, health, diseases, poisoning, etc.

a. To recognize and know how to treat the bites of spiders, insects, snakes, and other poisonous animals.

b. To recognize edible forms of plants and distinguish them from the poisonous types. For example, the types of mushrooms may be studied if they are important to the community. Certain types of native plants are used for food in almost all communities. The values, dangers, and precautions advisable in identifying, gathering, and preparing these foods can be pointed out.

c. To recognize the poisonous plants of the community such as ivy, poison oak, nettles, etc.

d. To recognize plants that are detrimental to health in peculiar ways such as the ragweed which is the main cause of hay-fever rather than the beautiful goldenrod, which has been wrongly blamed.

e. To understand how certain diseases and parasites are transmitted, when they are found in the community, and recognize the alternate host or peculiar transmitting agency. Cases of this type that may be found in the community are:

1) yellow fever
2) malaria
3) sleeping sickness
4) hookworm
5) tapeworm
6) trichinella
7) intestinal worms
8) typhoid and paratyphoid
9) tuleremia

4. To understand all of the health needs of the home, school, and community at large in terms of the scientific processes involved and the need for the complete establishment of the highest standards of health and sanitation.

a. The sanitary conditions of the swimming pools, showers, playgrounds, sewage and garbage disposal, and its relation to the control of contagious and infectuous diseases.

b. Analysis of the water supply.

c. Methods of combating flies and other insect pests.

d. The significance and need for refrigeration.

e. The control of bacteria through the boiling of drinking water, the pasteurization of milk, and similar processes.

5. To understand the civic, sanitary, and medical processes and services required for the control and abolition of contagious diseases of the community.

a. Study the scientific methods of combating contagious diseases such as isolation, immunization, and fumigation.

b. Study the contagious diseases of the community from the standpoint of methods of prevention, and the treatment for each when contracted.

c. Study the work of the members of the medical profession in relation to contagious diseases.

6. To understand the structure and physiology of the human body in relation to typical social situations in which the individual lives and engages in activities.

a. What habits shall be formed in view of the physical needs of individuals?

b. A knowledge of the functioning of the various systems of

the body and the interrelation of them as it affects the total operation of the entire organism.

c. What shall be the balanced regimen of exercise in relation to the types of vocations carried on by various individuals? What habits shall be formed in view of the physical needs of individuals? What is the effect of specialized and excessive exercise upon the balance of the organs and general health?

7. To understand the outstanding defects or problems of the community which show a general lack of adequate biological knowledge.

a. These should be well understood by the teacher and he should do everything in his power, in school and out, to remedy such defects, or, at least, to attack such problems. Is there a problem of the lack of proper sewage-disposal methods as indicated by general observation, or the prevalence of intestinal-borne diseases? Is there a general lack of knowledge of the transmission of disease germs as indicated by the spread of diseases in the community, the causative organisms of which are commonly spread by contact infection? To such problems as the foregoing, the biology teacher should be alert and he should inventory these in this survey.[1]

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[1] William E. Cole, The Teaching of Biology (D. Appleton-Century Company, New York, 1934), p. 47.

8. To become familiar with the general principles of biology that have a direct bearing upon health.

   a. The methods of water purification.

   b. The germ nature of disease. Some demonstration of such simple animals as paramoecian, amoeba, simple plants like pleurococcus, bacteria, to help students realize how small they are, how simple, and yet that they perform the usual life functions. Experience in growing molds, to get clear percepts of spores, and a realization that these lowly forms reproduce only their own kind. Knowledge of various forms of bacteria, like the bacillus of tuberculosis, the pneumococcus, the spirillum of anthrax.[2]

   c. What is being done in your community to safe guard the drinking water, the milk supply, the food supplies in stores? What is the work of the local and state health departments?

   d. What habits are most useful in avoiding communicable diseases? Have the students made a list of these? What methods can be used to cause a general adoption of these habits in the community at large?

B. The state as a major area in significant social relations.

   1. To understand the meaning and implications of eugenic laws and suggesting where these fall short of a balanced program.

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[2] L. W. Webb and others, editor, High School Curriculum Reorganization (The North Central Association, Ann Arbor, Michigan, 1933), p. 233.

a. Seek out the state laws that are devised for race improvement. How effective are our marriage laws in preventing the birth of undesirable and inefficient children? Study the application of the sterilization law as it applies to the inmates of state institutions. Examine the reports of the state institutions to gain an insight into the effectiveness of the sterilization law as now applied.

b. Study the statistics presented by the several state institutions to note the trend in feeblemindedness, insanity, and criminality. Has the problem been lessened since the enactment of the sterilization law? Why?

c. What has been the attitude of the churches toward eugenics? What is the attitude of the Medical Association?

C. The nation as a major area in significant social relations.

1. What has been accomplished by the National Government in health education and control, and what are the present plans of the National Health Administration in relation to the cities and communities?

a. What does the National Government do, if anything, in isolating and treating dreaded diseases; in preventing the pollution of water supplies; in preventing people from foreign countries from bringing new diseases into the United States; in caring for diseases peculiar to certain areas, such as malaria, yellow fever, typhoid fever, and

hook worm; sanitation in parts of the country in which the foregoing diseases and many others are prevalent?

b. What need is there for governmental research to secure adequate treatment and cures for various malignant diseases?

c. Knowledge useful in the control of situations of everyday life. Let pupils look up and report on the decrease in deaths from diphtheria since the discovery of antitoxin, the fall in the death rate from tuberculosis, the comparative death rate from smallpox among those that have been vaccinated and those who have not. What is a contagious disease? What are some of the common means of contagion? What is sterilization, pasteurization? Why do we have isolation hospitals?[3]

2. To emphasize the new developments in health and the need for cooperation and sympathy with the recent discoveries in mental hygiene; together with the proper humane and scientific treatment for mental cases.

a. Study of emphasis put on allowing more activity and throwing off restraint or introducing activity, should be made. Promote healthful thinking for our commercialized recreations so they will not be used to an excess; for example, golf might become a means for showing off instead of just recreation.

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[3] Loc. cit.

The solution of our problems, such as retreat from reality, adjustment by defense, timidity, phobias, etc.

Adjustments between parents and children. Motives for our actions; for example, to maintain self-esteem. A personal survey of our attitudes and ideas and trace their source.[4]

D. The major area of international relations.

1. What the great bacteriologists, as for example Pasteur, have accomplished for the advancement of health throughout the world, as well as other scientists in the fields of nutrition, physiology, surgery, etc.*

a. Here a study of inoculations should be made. Smallpox was probably the first common international disease to be conquered. Between 1700 and 1800 this terrible scourge killed about 60,000,000 people in Europe. Study the work of Edward Jenner, an English doctor, beginning about 1796 in preventing smallpox by means of the development of vaccination. The next study should center around the work of a Frenchman, Louis Pasteur, born in 1822. It was he who discovered that germs in liquids could be killed by heating such as were found in wine, in milk,

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[4] High School Curriculum Class under the direction of H. C. Lull, "General Distribution of Intermediate Objectives Among Senior-High School Subjects," (unpublished report, 1936), p. 19.

* This is properly in the field of history, but until that department properly handles this body of knowledge, biology and other science courses will have to continue to do so.

and in water. He first found a way of preventing the disease of anthrax in cattle; while Pasteur was working to conquer anthrax, Robert Koch, a young country doctor in Germany, found the bacteria which caused the disease. Pasteur's final achievement was the finding of a serum which prevents hydrophobia. This disease had caused the lives of hundreds of people bitten by mad dogs. Later Koch found the germs that cause tuberculosis. In this connection a thoroughgoing study of the conditions of infection of tuberculosis, its development, and treatment, should be made.[5]

b. Explore the field in the development of surgery. The first surgeons were barbers who amputated various external portions of the body. The first real advancement in surgery was accomplished by Joseph Lister, born in England in 1827. He worked out two ways of preventing infections, viz., antisepsis (meaning against germs), and asepsis (meaning without germs).

c. In addition to the above mentioned men, survey the work of such internationally famous biologists as Harvey, McCollum, Lazear, and Leeuwenhoek.

2. What the League of Nations does in cooperation with other agencies to improve the health of the world.

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[5] Ibid., p. 25.

a. The health work of the League of Nations should be studied in relation to its contribution to the health of the nations. This study should include the general set-up and organization of the health committee of twenty members which directs the work through a health director working under the health section of the League Secretariat; The Far East Commission, the Standards committee of the serological and biological standards, the sub-committees for the study of the malaria problem, cancer, tuberculosis, sanitation in public health, tropical diseases, sanitary control of travel on water ways, etc.[6]

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[6] Ibid., p. 26.

CHAPTER VI

CITIZENSHIP

I. Citizenship activities, emphasizing activities, knowledge, and attitudes involved in the relationships of the home, the school, the church, business, industry, professions, and other social agencies.

A. The community as a major area in significant social relations.

1. To understand the essential social relations within the home with the view of making the home a better place in which to live for all of the members of the family.

a. Show the economic as well as the biological dependence of children within the home.

b. Note the change which is taking place in regard to the social and industrial equality of the sexes.

2. To understand the needs of education for parenthood and the essential factors involved in that education.

a. What is meant by biological inheritance. The responsibility of parents for the morals, health, and economic necessities of their children.

3. To understand the problems involved in the eugenic well-being of the people of the community.

a. It may be shown how certain unit characteristics are transmitted. Consider the effect of a disproportionate

increase of undesirable characteristics.

b. The working of natural law within the community through eliminating those unfit to compete in the industrial and physical conditions peculiar to the locality.

4. To understand the tremendous economic and social significance of the conservation of natural resources around your community and in your state.

a. Soil, the forests, and plant and animal life are especially pertinent to the biology course.

5. To understand the problems involved in the development of the best use and the administration of the occupations of leisure time in your community.*

6. To understand the scientific, social and occupational needs of the community.

a. Are there serious health needs to be met? Is there a general lack of desired interest in home landscaping and home beautification? These may be only two of a great many community needs which the biology course should help meet in one way or another.[1]

b. The major activities of the biology course should reflect the occupations which determine the livelihood of the people of the community. The activities and projects in

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* Cf. post, Chapter VIII.

[1] William E. Cole, The Teaching of Biology (D. Appleton-Century Company, New York, 1934), p. 46.

a predominantly agricultural community will be radically different from those of one which is largely industrial.

7. Acquiring right habits of conduct and useful skills.[2]

a. List the desirable personal habits that are the chief means of avoiding communicable diseases. Make out a score card so pupils can record their observance of such habits for a week or two. How shall we get such habits across to the community?

B. The state as a major area in significant social relations.

1. To understand such public problems as will be considered by the future citizens you are now training.

a. Conservation, the prevention of stream pollution, the establishment of public institutions for the indigent, the purification of water supplies, and the beautification of the home are vital questions for the future citizens to begin thinking about.

b. The problems of over-population may be considered and a study made of the methods of controlling population and adjusting it to the resources of the state.

C. The nation as a major area in significant social relations.

1. To place definite and distinct emphasis on the problem of conservation in the larger sense, i.e. the conservation of

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[2] L. W. Webb and others, editor, High School Curriculum Reorganization (The North Central Association of Colleges and Secondary Schools, Publication Office: Ann Arbor, Mich., 1933), p. 234.

human energy and life, of biological resources, and their social and economic implications.

a. The biological futility of war can be shown to run counter to nature's method of the selection of the best for survival.

b. The work of the U. S. Biological survey is largely along the line of protecting wild life and the prevention of damage by enemies.

2. To understand the bearing of the euthenics vs. eugenics controversy or of euthenics-eugenics cooperation upon the problem of the fluctuating quality of our national citizenry.

a. Regarding the age-long controversy between environment and heredity, the present tendency is to admit the all-important effects of each upon the bringing about of the integrated characteristics of the individual. Such characteristics as social attitudes, behavior, and personality factors are almost entirely the result of environment, training, or social inheritance; while physique, mental capacity, and physiological equipment are dependent mainly upon biological heredity. Naturally there is an inseparable interrelationship between the two, since training in hygiene vitally influences one's physiological functioning; and conversely one's physiological efficiency profoundly affects his personality.

B. The International area as a major area in significant social relations.

1. To stress the importance of the struggle of our species with other living species, e.g., insects, bacteria, etc., and thus to dramatize the need for closer and more cordial cooperation as among the groups and races of our species.

a. If the money that is spent in fighting other human beings could be directed to some of the enemies of mankind, man might possibly win the war with the insects, the bacteria, and other obnoxious forms of life that threaten his supremacy.

b. All races of the human species have the same fundamental problems.

2. To sow the seeds of world citizenship as opposed to the provincial type of patriotism.

a. To teach important facts concerning the lives of men who have made great discoveries in the biological sciences in the past, and to help pupils acquire an appreciation of possible future developments in biology.[3]

b. To recognize and appreciate the great biological urges common to all races.

c. To develop a live-and-let-live attitude. Cause the student to realize that the world is his country.

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[3] William E. Cole, Op. cit., p. 40.

CHAPTER VII

LANGUAGE

I. Language activities in terms of reading, listening, writing, and speaking--getting socially significant ideas and expressing them in areas of important social relations.

A. The major areas of the community, state, national, and international relations.

1. To acquire the ability to express oneself in writing fluently, effectively, grammatically and with a minimum of errors in spelling and punctuation in the field of science.

a. There are various methods of bringing about articulation between biology and the other secondary sciences and between biology and other subjects.

Biology, English, and the social studies should be closely articulated. The quite general requirement of themes and reports in the social studies and English makes it possible to utilize biology topics for some of the written work in these subjects. This may be worked out through a conference of the teachers of the different subjects and by setting up topics for reports which will tend to bring about this articulation. As an example, there is good-citizenship training, biological training,

and English training in the subject of conservation.[1]

b. The notebook which is invariably a part of the course should be more than an array of biological data. It should be systematically arranged, and the same quality of composition, grammar, and spelling should be sought as is exacted of students in their English courses.

2. To help pupils acquire a working vocabulary in biology, thus enabling them better to appreciate, understand, and enjoy literature dealing with biological subject-matter. A reasonable study and drill on the glossary of the biology text is a worth-while objective.[2]

a. Much of the coarse or vulgar talk which pupils may indulge in is often partially relieved by the learning of the proper scientific name for certain functions and organs.

b. Word study including the definitions of biological and general scientific terms are a necessary part of the biology course, if the student is to be able to read and intelligently report upon printed material.

3. To aid pupils in acquiring methods of gaining for themselves information in the biological sciences.

a. Such matters as the use of dictionaries and reference books can be encouraged and effectively taught as a part

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[1] William E. Cole, The Teaching of Biology (D. Appleton-Century Company, New York, 1934), p. 72.

[2] Ibid., p. 40.

of the science course.

b. Books can be suggested to the pupils for leisure time reading or they may be reported upon. Also certain periodicals can be introduced to the class as valuable sources of information relative to the topic at hand.

4. To acquire an appreciation of the qualities of heroism displayed by men who have accomplished socially constructive results in the fields of invention and scientific discovery as displayed through the study of their careers.

a. No form of literature is more stimulating and generally worth-while than biography. The biology teacher has ample opportunity to familiarize students with the lives and works of numerous outstanding men in the field.

CHAPTER VIII

LEISURE-TIME

I. Leisure-time activities, in terms of enjoyable mental and physical activities, which tend to improve health and social relations in general, as well as personal attitudes and appreciations.

A. The community as a Major area in significant social relations.

1. To develop interest in travel, biography, fiction, science, economics, etc., through writing, through silent reading, through oral reading to others, through exposition and demonstration to others, through listening to others, through talking pictures, and through conversation with others.

a. Leisure-time activities are so ever-present in connection with biological implications that almost every thing in the course can be couched in a leisure-time setting. If the work in the fields of the other major objectives is well done, perhaps the leisure-time aspects will be amply handled without considering it as a separate objective. However, many biology teachers consider leisure-time as one of the most significant phases of the subject. No doubt, this is the reason that much in this chapter will sound like a duplication of what is to be found in others, since the leisure-time aspects are so intimately related to such objectives as health, citizenship, language, worthy

home membership, and even character.

b. Pupils and people generally seem to be very easily stimulated to an interest in nature study or some form of biological hobby. This may lead to greater observation, more interesting conversation, a more wholesome interest in travel, reading, and use of spare time. One may find an avenue for expression through writing or demonstration that will further satisfy the need for leisure-time activities.

c. Certain phases of biological hobbies and interests are of great economic importance. This is true of bird study, insect study, and the study of numerous forms of wild life.

d. To insure wise use of leisure time the biology course may stimulate interest in such hobbies as bird study, the use of edible mushrooms, insect collecting, gardening, apiculture; it may put the pupil in touch with a wealth of fascinating reading such as the lives of noted biologists, books of explorations like Wallace's Island Life, Beebe's Gallapagos, World's End, and Roosevelt's African Game Trails.[1]

2. To develop interests and activities in relation to the whole range of natural phenomena and their explanation on the basis

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[1] L. W. Webb and others, editor, High School Curriculum Reorganization (The North Central Association, Ann Arbor, Michigan, 1933), p. 228.

of natural laws.

a. A study of the life history of the bee, pigeon, chicken, with a view to rearing some one of them as hobby. The way in which a plant grows and the factors of moisture, light, heat, in limiting growth: this as preparation for acquiring skill in gardening. A study of some of the fascinating life histories of insects, snails, ferns, that may lead to the enthusiasm of the collector.[2]

3. To acquire a wide acquaintance with the great theories of biological and physical phenomena, both for the sheer intellectual delight of understanding them and for the extension of range and comprehension which such understanding will give to one's reading, writing, and conversation.

a. The evolutionary theories of Darwin, LaMarck, DeVries, etc.

b. The electron theory and other physical theories.

c. The various theories of inheritance.

4. To emphasize activities, knowledge, and attitudes involving economic, social, and moral welfare with the view of making the community a better place in which to live.

a. Leisure-time activities are essentially contributors to citizenship. With the release from drudgery which is one

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[2] Ibid., p. 230.

of the fruits of the technological age, the problem of what to do with the increased leisure has become one of the main current problems.

b. Bird study, to those who have come to know of its charms, is one of the hobbies that fulfills all of the missions that a hobby should perform. It is stimulating, requires exercise in the open, is socially desirable and economically important. Bird study is more than a trifling fad. Our bird life represents valuable public property, which although protected by law, is receding before an uninlightened, disinterested, unsuspecting public. The birds of the community should be studied with these purposes:

1) identification of the common species;
2) knowledge of their food habits, nesting habits and song;
3) knowledge of their natural enemies--cats, squirrels, snakes, other birds, etc.;
4) notice their migratory habits;
5) decide upon the ones that should be protected because of their economic or esthetic value or both;
6) learn the obnoxious species and the best methods of control.

c. Insect study goes hand in hand with the study of birds. The habits, importance, esthetic and economic value, and

interesting characteristics of the common insects of the community should not be slighted in the biology course. Ignorance of the habits of insects is so common that lady beetles, dragon flies, praying mantis, and many other very useful insects are as readily destroyed by well-meaning persons as are the destructive forms.

d. Other forms of life common to the community can be studied in about the same manner as birds and insects, i.e:

1) their general habits;

2) their economic importance;

3) man's power to protect or control them.

B. The State and Nation as Major Areas in significant social relations.

1. To understand what our State and Nation are doing, have done, and what should be done to provide mental recreation in forms of libraries, museums, art galleries, and schools which give attention not only to physical but also mental recreation.

a. An effort should be made to cause students and people generally to appreciate and understand the reason for the considerable expenditure of money for museums, parks, zoos, and for the preservation of all forms of nature and natural areas.

2. To understand how to find the beauty spots in the states and the nation, especially those that can be reached by short drives from our own community.

3. To understand the many fields of interest that may be opened up through a pursuit of the ramifications of the subject.

   a. Many new fields of interest for leisure-time reading may be opened to the biology student. The biography and life work of those leaders who have adorned the field of biology, while it is primarily history, must be presented in biology until history enriches its scope to the point where it recounts the deeds of the scientific heroes, as well as the political and military heroes of the world.

   b. The worthy use of leisure time is becoming more and more a problem in our industrial American society. Biology may train for avocation and the worthy use of leisure by giving the knowledges and interests necessary for the establishment of such hobbies as gardening of all types, collecting, preserving, mounting, photography, hiking, painting, fur farming, raising of pets, and reading. The content of biology is more and more appearing in our contemporary literature. For an intelligent interpretation of, and proper appreciation for, such literature, some knowledge of biology and of the workers in the biological sciences is becoming encreasingly desirable.[3]

   c. Webb[4] has suggested the following:

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[3] William E. Cole, The Teaching of Biology (D. Appleton-Century Company, New York, 1934), p. 36.

[4] Webb, Op. cit., p. 230.

Selected readings from Thoreau, Burroughs, William Hamilton, Gibson, J. Arthur Thompson, and Fabee, to catch their attitudes of contagious enthusiasm and their appreciative points-of-view.

CHAPTER IX

VOCATIONS

I. In all the major areas of significant social relations.

A. Curriculum objective: Vocational activities, emphasizing guidance in the choice of vocation, experience in the vocation when chosen, the social, civic, and health relations of the vocations, and especially of the one which one expects to enter.

1. To become informed regarding the opportunities offered in the various vocations and professions in the community, which have a bearing upon some phases of biology; to know the preparation and personal requirements of these vocations and professions, and the pupil's capacity for success in each.

a. It is easily shown that the medical profession has its foundation almost entirely in the rudiments of biology such as anatomy, physiology, endocrinology, and bacteriology.

b. The teaching profession and various types of research workers depend on few or many branches of biological science.

c. Sanitary and municipal engineers have need for as much foundation in biology as in physics and chemistry.

d. Farming is purely applied biology. Make a list of the biological pursuits connected with this industry. The

agricultural colleges are built around the science of life.

2. To acquire the basic experiences essential to success in a chosen vocation.

   a. It is difficult to determine whether the skills and experiences acquired in a course in biology are to be useful to the student in a vocational or an avocational way. In either case, however, these experiences are economically valuable. As one writer has stated it:

> Under each specific objective that may be classed as a leisure-time occupation there will be many desirable skills. For instance in gardening, one needs skill in handling the ordinary tools, in soil preparation, in planting, in transplanting, in grafting, budding, layering, pruning, etc.[1]

   b. The knowledges, attitudes, mental techniques, and skills involved in meeting the demands of health, leisure, social relationships, and vocation are to be the immediate concern of all teachers so far as their respective subjects may contribute. The specific determination of both the immediate objectives and a subject's possible contribution to them will require much patient analytical thinking, much use of subjective judgment, and, perhaps, much more guessing. This route to curriculum revision is arduous

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[1] L. W. Webb and others, editor, High School Curriculum Reorganization (The North Central Association, Ann Arbor, Michigan, 1933), p. 231.

but not impossible. At any rate there seems to be no other, if subjects are to be retained and pupils genuinely prepared for life.[2]

3. To become informed regarding the opportunities offered in the various vocations and professions, in the state, nation, and in the other nations.

   a. Study the game laws of the state and the various methods used in preserving and protecting the wild life and natural areas. What state officers have a part in this program?

   b. List the biological jobs in connection with the United States Department of Agriculture. e.g.,

      1) The Biological Survey.

      2) The care of national forests and parks.

      3) Insect and weed control, etc., etc.

   c. Consider the work of federal agents who are sent to foreign countries in the interest of plant improvement, introduction of new varieties, natural enemies of insect and other pests, and detecting other factors relative to agriculture.

Some typical statements from educational leaders regarding the possibilities of biology in vocations are as follows:

> Analyses of the major activities of the men and women of the community. These major activities should be reflected in the biology course as the teacher attempts to tie up the subject-matter of the course with the occupations which determine the livelihood of the

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[2] Webb, Op. Cit., p. 14.

people of the community. In predominantly agricultural communities, biology should be correlated through field trips, problems, projects, activities, and illustrations with the farm and home life of the community.[3]

To provide pupils with facilities and opportunities to explore the various fields of the biological sciences for purposes of vocational and educational guidance.[4]

To train pupils to acquire greater facility in the application of scientific method and science knowledge to the study and solution of problems of whatever kind.[5]

Two phases of biology teaching relate directly to the vocational objectives of secondary education, namely, the guidance or exploratory phase. Of the two probably the former is more important in biology but neither one is to be overlooked. It would seem that if the exploratory functions of the junior high school, and the first two years of the four-year high school are to be fully realized, and some writers are advocating biology as a requirement.[6]

The study of biology may discover to the student his vocational interests and aptitudes, as in farming, animal husbandry, forestry, floriculture, anatomy. It may prepare the student for certain social relationships. The elements involved in the adjustment of the plant or animal to its environment are duplicated in man's adjustment to his social surroundings. A comprehension of Mendel's laws and their application to human inheritance is an important aid in founding a successful home.[7]

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[3] William E. Cole, The Teaching of Biology (D. Appleton-Century Company, New York, 1934), p. 46.

[4] Ibid., p. 39.

[5] Ibid., p. 40.

[6] Ibid., p. 35.

[7] Webb, Op. cit., p. 228.

CHAPTER X

GENERAL PRINCIPLES

A chapter might have been added on Character, also on Worthy Home Membership, but it is doubtful that many more specific objectives could have been listed under these headings that have not been covered in other chapters. Rather it would seem that there is a great contribution to be made to these Cardinal Objectives in many of the unit objectives listed for study and investigation. The teacher who sees the importance of these phases of the subject will find ample ways of introducing training in character and worthy home membership. The important thing then seems to be to cause the instructor to see the value and necessity of this training as a phase of his teaching of science.

> Certain biological principles, processes, and knowledges involved in homemaking contribute very directly to worthy home membership. Among these are the care of milk, the souring of milk, the action of yeast in breadmaking, care of wounds, home sanitation, bulb culture, landscaping, flower gardening, the growing of plants, and biological hobbies which may involve the effective use of leisure time.[1]

An equally strong appeal for aiming at character training as an outcome of the curriculum in general is presented by Mr. Briggs[2] when he writes:

> There is a conflict between the theory which approves the common organization into subjects and the minority but strengthening theory

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[1] William E. Cole, The Teaching of Biology (D. Appleton-Century Company, New York, 1934), p. 35.

[2] Thomas H. Briggs, "The Issues in Secondary Education," The Journal of the National Education Association, 25:105, April, 1936.

> of organization of experiences into functional categories. Of course practise all but universally approves the former type, but there are in practise many significant innovations of the second. . . If education is concerned with the development of the whole personality, it cannot neglect attitudes and ideals, especially as their sum is equivalent to what is generally recognized as character.

There are so many strong statements from leading educators stressing the importance of these sidelight outcomes of the curriculum that one hardly knows when to stop quoting them. However, this one by Francis Flynn seems worthy of mention:

> When each individual teacher can answer the challenge with a smile of confidence and demonstrate to all that his course serves in a small way to develop a useful member of society and, above all, a happy, contented individual; then, and then only, will the challenge of society have been answered.[3]

As part of the pupil's intellectual training, biology teaching should set up learning situations through which biology pupils will acquire certain scientific attitudes toward biological phenomena and problems.

This scientific attitude in itself is really a very important phase of character. As Mr. Cole has said:

> Biology teaching may contribute to ethical character by helping the pupil acquire and establish a more adequate conception of truth; by teaching him the value of cooperative work; by promoting confidence in the laws of cause and effect; by teaching the pupil to do his task well; by helping the pupil to acquire a rich inner life of understandings, appreciations, and feelings; by teaching him to evaluate and discuss critically and constructively; and by the conscious direction of his behavior toward desirable patterns both in and out of the classroom environment.[4]

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[3] Francis Flynn, "New Life in an Old Curriculum," The Nation's Schools, 17:25, May, 1936.

[4] Cole, op. cit., p. 37.

Specific objectives or rather outcomes that are as good as any to be found are listed by Mr. Cole.[5]

(1) To bring about in the biology class a learning situation which will give pupils a command of such factual biological information as is most directly and obviously related to their welfare and to intelligent living.

(2) To correct common superstitutions, unfounded beliefs, and ignorant practices and to help pupils acquire the cause-and-effect relationship concept.

(3) To bring about learning conditions which will provide pupils with practice in reflective thinking.

(4) To train pupils to apply the knowledges, skills, experiences and concepts acquired in biology class to the solution of problems outside the classroom. The amount of transfer and consequential application of the knowledges and skills acquired in the biology class to life situations will be governed to a large degree by the similarity of the elements in the biology class and life outside. Indeed, education has been defined as the art of utilizing knowledge.

(5) To aid pupils to acquire scientific techniques and manipulative skills, to formulate workable hypotheses, to base judgment on fact, and to change opinions on the basis of new and adequate factual evidence.

(6) To aid pupils in acquiring a grasp of certain great biological principles, or "fundamentals," which are common to all living things.

The study of natural laws and phenomena often makes a contribution to character training perhaps more effective than units of work consciously so directed. It would seem to be a logical outcome of such study since ". . .the pupil must acquire an appreciation of the lawfulness of nature, and assume the attitude that he is bound to conform to such laws."[6]

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[5] Ibid., pp. 39-41.

[6] L. W. Webb and others, editor, High School Curriculum Reorganization (The North Central Association, Ann Arbor, Michigan, 1933), p. 239.

The newer methods of teaching make due allowance for the development of such desirable outcomes. No longer is subject-matter presented in cut-and-dried doses, but ample provision is made for the thought processes of the students to pursue the byways which the topic at hand suggests. Many teachers have found this practice more desirable from the standpoint of pupil development than having the trend of the study "too" carefully planned and directed. What teacher knows precisely to what extent and in what direction the lesson should go to be most significant and beneficial?

> Immediate and unquestioning obedience was the criterion of successful classroom management under this regimen, and efficient instruction consisted in the careful following of the detailed plans with teacher-determined prescriptions of subject matter to be taken in exact doses at specified hours of the day.[7]

> The secondary school has been absorbed with imparting information. It has had to make its students memorize dates, boundaries, exports, theorems, reactions, laws, and to pour facts into their docile heads to enable them to pass examinations for college. Now we are beginning to see that this kind of education is not enough.[8]

This is an artful description of an unfolding philosophy of education at work. One wonders if the apparent apathy and lack of interest on the part of students is not the fruits of this system of teaching. One writer sees a distinct change in the outlook of students, however, and may be heralding a new era in our school system.

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[7] William C. Olson, "Child-Teacher Relations are Experiencing a Shift in Emphasis," The Nations Schools, 17:20-21, April, 1936.

[8] Harry H. Moore, "Gangsters, Slums and Demagogues in Secondary Education," Progressive Education, 13:275, April, 1936.

> There is an abundance of specific evidence and general evidence that that much-discussed spirit of flaming youth has been disappearing, and that young people of today have an interest in the welfare of society and a seriousness of purpose not observed in any previous generation. Many groups are discussing social and economic problems; some are undertaking programs of action. While in the colleges there is more organized activity, in the secondary schools there is probably a larger proportion of students with social impulses. Thousands of these younger adolescents are now ready to look the present social crisis squarely in the face and to tackle the job of building a better world.[9]

If the amount of interest and activity in revising the curriculum is any criterion, then our schools are on the verge of a consumating change. Educational magazines are devoting a tremendous amount of their space to this field. Indeed one writer foresees the school taking over the work of the disintegrating family.

> The public school, as a vital agency in cultural development, is faced with this dual problem. On the one hand there is the institutional temptation to push the development of infant education in preliminary and nursery units and thus increase its institutional prominence and power. On the other hand, the school has the possibility of stimulating the evolution of the democratic family unit through a rational program of parent and child education in the art of home building.[10]

The biology teacher will have no difficulty in finding plenty of opportunities to carry the virtues of his subject into fruitful expression.

> Every community is rich in subject-matter that may be effectively used in the teaching of biology. The teacher should make an inventory of these local resources and draw upon them frequently. Outstanding defects of problems in the community which show a general lack of adequate biological knowledge. These should be well understood by the teacher and he should do everything in his power in school and out to remedy such defects or at least to attack such problems. Is

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[9] Ibid., p. 277.

[10] Editorial, "Shall We Discard the Family," The Nation's Schools, 17:14, April, 1936.

> there a problem of the lack of proper sewage-disposal methods as indicated by general observation, or the prevalence of intestional-borne diseases? Is there a general lack of knowledge of the transmission of disease germs as indicated by the spread of diseases in the community, the causative organisms of which are commonly spread by contact infection? To such problems as the foregoing, the biology teacher should be alert and he should inventory these in his survey.[11]

The writer has attempted to set forth a few fundamental objectives for a biology course. An attempt has been made to keep it consistent with progressive thought.

> The first thing necessary in the curriculum making is a clear-cut statement of objectives. If these objectives are to be of real value they must be so definitely expressed as to serve in two capacities: first, as standards by which the worth of present curriculum materials may be judged; and second, as unequivocal guides in the selection and organization of new materials.[12]

Naturally, many of the objectives, especially in the community area could not be made specific. It is hoped that the text is not too general and that the biology teacher will find it helpful in suggesting possible avenues for making his work socially valuable.

> Clearly the trend in curriculum revision is toward conservative and practical experimentation. The need for changes and improvements is very generally recognized, but the practical administrator knows that these changes can be made permanent and effective only after careful study and experimentation, after adequate preparation on the part of teachers and community, and after due allowance has been made for local conditions and needs.[13]

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[11] Cole, op. cit., p. 47.

[12] Webb, op. cit., p. 12.

[13] A. L. Spohn, "Trends in Curriculum Changes, 1934-1935," The North Central Association Quarterly, 10:444, April, 1936.

B I B L I O G R A P H Y

A. BOOKS

Allen, Arthur A., The Book of Bird Life. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, 1930. 426 pp.

A study of birds in their native haunts; well illustrated.

Baird, Don O., A Study of Biology Notebook Work in New York State. Teachers College, Columbia University, New York, 1929. 118 pp.

A good cross-section of the type of work done. Well illustrated.

Briggs, Thomas H., Curriculum Problems. The MacMillan Company, New York, 1927. 138 pp.

This little book bears careful consideration. One feels, after reading this book, that he has encountered a genuine, wholesome, educational philosophy. The central theme of the book is that the emotional elements in ones every act and attitude are capable of analysis, training, and change. Many practical curriculum questions are set up and attacked by way of the emotions rather than the intellect.

Caswell, Hollis L., and Doak S. Campbell, Curriculum Development. American Book Co., New York, 1935. 600 pp.

A comprehensive treatment of the evils and shortcomings of the traditional program with the needs of the present economic and social orders clearly defined.

Cole, Fay-Cooper, The Long Road From Savagery to Civilization. The Williams and Wilkins Company, Baltimore, 1933. 100 pp.

An excellent treatise on anthropology and the development of human culture.

Cole, William E., The Teaching of Biology. D. Appleton-Century Company, New York, 1934. 252 pp.

The book brings out the relation of the modern concepts of education to the teaching of biology. Concise treatments are included on the history of biology, it's present status, teacher training, it's relation to various conceptions of culture, and the philosophical aspects of education approached through biology.

Comstock, Anna Botsford, Handbook of Nature-Study. Comstock Publishing Co., Inc., Ithaca, New York, 1935. 942 pp.

An invaluable book for the elementary school teacher. Perhaps the best book of its kind available. The book is well classified into small workable units for study. Well illustrated, inspirational, and scientifically accurate.

Crampton, Henry E., The Coming and Evolution of Life. The University Society, Inc., New York, 1931. 103 pp.

How living things have come to be as they are. Highlights of modern knowledge of the subject.

Cubberley, Elwood P., Public Education in the United States. Houghton Mifflin Company, Boston, 1934. 782 pp.

A very valuable source book. Almost an encyclopedia of education in the United States.

. . . . ., Readings in Public Education in the United States. Houghton Mifflin Company, Boston, 1934. 534 pp.

A collection of sources and readings to illustrate the history of educational practice and progress in the United States.

Curtis, Winterton C., Science and Human Affairs. Harcourt, Brace and Company, New York, 1922. 330 pp.

Sets forth the humanistic aspect of natural science with illustrations largely from the field of biology.

Darrow, Floyd L., The New World of Physical Discovery. The Bobbs-Merrill Company, Indianapolis, 1930. 371 pp.

The progress of the centuries is unfolded in logical order. While written in a thoroughly popular style, the treatment sacrifices nothing to scientific accuracy.

De Kruif, Paul, Microbe Hunters. Harcourt, Brace and Company, New York, 1926. 363 pp.

Biography of each of the great contributors to microbiology together with a rather detailed account of his work.

Demiashkevich, Michael, An Introduction to the Philosophy of Education, American Book Company, New York, 1935. 449 pp.

Written to lead the teacher or student to formulate a philosophy of his own by becoming familiar with many points of view. The author discusses major movements in education and takes a definite stand regarding the "ultra-new in progressive education." Combines a study of the past with a keen observation of present day experiments.

Dendy, Arthur, The Biological Foundations of Society. Constable and Company Ltd., London, 10 and 12 Orange Street, Leicester Square W. C. 2, 1924. 1924. 197 pp.

The outcome of a series of lectures delivered by the author at King's College.

Dorsey, George A., Why We Behave Like Human Beings. Cornwall Press, Inc., Cornwall, N. Y., 1925. 512 pp.

Man as an organism is run through the gamut of every phase of zoology from embryology to psychology.

Fernald, H. T., Applied Entomology. McGraw-Hill Book Company, Inc., New York, 1921. 386 pp.

An introductory text-book of insects in their relations to man.

Furnas, C. C., The Next Hundred Years. Reynal and Hitchcock, New York, 1936. 434 pp.

A most readable although entirely scientific book written in a thoroughly popular style. The author sub-titles it as the "Unfinished Business of Science."

Gallagher, Edward J., Vocational Guidance and Success. The Bruce Publishing Company, Milwaukee, 1931. 201 pp.

Designed to assist the student in the discovery and development of his natural talents. Health, education, and character are emphasized as essential prerequisites to the pursuit of any vocation.

Gregory, J. W., Geology of To-day. Seeley, Service and Company, Ltd., London, 1915. 328 pp.

A fascinating introduction to the subject, written in simple language. Well illustrated. Part IV, which the author calls, "The Story of Life on the Earth," is especially significant to this treatise.

Gruenburg, Benjamin C., Elementary Biology; An Introduction to the Science of Life. Ginn and Company, Boston, 1919. 528 pp.

The author covers the field and problems of biology in a skillful and scientific manner. The book is well illustrated, interesting, and well adapted for reference work.

Haldane, J. B. S., Daedalus or Science and the Future. Kegan Paul, Trench, Trubner and Company, Ltd., Broadway House, London; 68-74, Carter Lane, E. C., 1924. 93 pp.

A delightfully readable little book; inspirational and thought-provoking. The possibilities and probabilities of science are depicted in a scholarly way. The philosophical implications growing out of the conflict of science with religious dogma is skillfully handled by the author.

Harap, Henry, The Technique of Curriculum Making. The Macmillan Company, New York, 1928. 315 pp.

The steps in curriculum reconstruction are outlined. Illustrations are drawn from actual curriculum investigations and courses of study.

Herrick, C. Judson, An Introduction to Neurology. W. B. Saunders Company, Philadelphia, 1931. 417 pp.

The biological and educational aspects as well as the purely technical side of the subject is presented.

Herter, Christian A., Biological Aspects of Human Problems. The Macmillan Company, New York, 1911. 344 pp.

The title expresses what is to be found in the book.

Hodge, Clifton F., Nature Study and Life. Ginn and Company, Boston, 1902. 514 pp.

Somewhat sentimental, although an excellent general treatment on biology.

Holmes, Samuel J., The Trend of the Race. Harcourt, Brace and Company, New York, 1921. 396 pp.

A study of present tendencies in the biological development of civilized mankind.

Hopkins, L. Thomas, Curriculum Principles and Practices. Benj. H. Sanborn and Company, Chicago, 1929. 617 pp.

The author effectively carries out his acknowledged purposes of the book. These are as follows:

(1) To give school administrators a workable plan for curriculum reconstruction.
(2) To furnish a basic textbook for curriculum classes in college.

Haldane, J. B. S., Daedalus or Science and the Future. Kegan Paul, Trench, Trubner and Company, Ltd., Broadway House, London; 68-74, Carter Lane, E. C., 1924. 93 pp.

A delightfully readable little book; inspirational and thought-provoking. The possibilities and probabilities of science are depicted in a scholarly way. The philosophical implications growing out of the conflict of science with religious dogma is skillfully handled by the author.

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(1) To give school administrators a workable plan for curriculum reconstruction.
(2) To furnish a basic textbook for curriculum classes in college.

(3) To present for members of curriculum committees a set of procedures by which their work can be effectively performed.
(4) To define a minimum body of fundamental materials concerning the school curriculum, an understanding of which is essential to all good teaching, from the kindergarten through college.

Horsfall, R. Bruce, Bird and Animal Paintings. Nature Magazine, Washington, D. C., 1928. 58 pp.

Contains twenty-eight pages of color plates. Each of these pages pictures six animals. Eighteen pages of birds, eight pages of mammals, and two pages of butterflies are included. Each animal is completely and accurately described on the page back of its picture.

Horsfield, H. Knight, Side Lights On Birds. Heath Cranton Limited, 6 Fleet Lane, London, In the U.S.A. by D. Appleton and Company, New York, 1923. 224 pp.

An introduction to the study of British bird life.

Hunter, George William, A Civic Biology. The American Book Company, New York, 1914. 430 pp.

A well illustrated, inspiring, elementary text.

Huxley, Thomas H. Method and Results. D. Appleton and Company, New York, 1896. 430 pp.

Autobiography and nine essays by the famous naturalist.

. . . ., Darwiniana. D. Appleton and Company, New York, 1896. 475 pp.

Ten essays and six lectures by the famous biologist. The book includes criticism, eulogy, and discussion of Darwin and his ideas.

Kallet, Arthur, and F. J. Schlink, 100,000,000 Guinea Pigs. The Vanguard Press, New York, 1933. 312 pp.

The book reveals the dangers in everyday foods, drugs, and cosmetics.

Keating, M. W., editor, The Great Didactic of Comenius. Adam and Charles Black, London, 1896. 468 pp.

Some surprising views on natural law and teaching methods for a man born in the sixteenth century.

Kellogg, Vernon, Human Life As The Biologist Sees It. Henry Holt and Company, New York, 1922. 140 pp.

Written in lecture style and dealing with the pertinent problems of life and civilization.

Kilpatrick, William H., and others, The Educational Frontier. D. Appleton-Century Company, New York, 1933. 325 pp.

Seven leading educators present their philosophy of education which presents a united front for progressive, practical, dynamic education.

Kinsey, Alfred C., New Introduction to Biology. J. B. Lippincott Company, Chicago, 1933. 840 pp.

502 illustrations, stimulating and inspirational. Dedicated to--That which is interesting in the world.

Knight, Charles R., Before the Dawn of History. Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1935. 119 pp.

A book on paleontology that the high school pupil can understand and appreciate. Contains forty-five full-page illustrations of the forms of life during the various geological ages.

Lederer, Norbert, Tropical Fish and Their Care. Alfred A. Knopf, New York, 1934. 229 pp.

General instructions on care of fish and other forms of life in aquaria. All known species of tropical fish are adequately described.

Lincoln Library of Essential Information. The Frontier Press Company, Buffalo, New York, 1931. 2174 pp.

An up-to-date manual of reference materials. A condensed encyclopedia.

Longyear, William, How to Make Garden Pools. Doubleday, Doran and Company, Inc., Garden City, New York, 1936. 96 pp.

Thoroughly illustrated by the author and written in an interesting and stimulating style.

Lull, H. G., Director, General Guidance Bulletin for Schools of East Central Kansas Cooperating in the Improvement of the Curriculum March, 1936. 84 pp.

The curriculum objectives and areas of service in this study were taken directly from this bulletin.

Lull, H. G., Principles of Elementary Education. W. W. Norton and Company, Inc., New York, 1935. 532 pp.

A valuable contribution in the field of curriculum and teaching procedures. It is richly interspersed with sound educational philosophy.

. . . ., Secondary Education: Orientation of Program. W. W. Norton and Company, Inc., New York, 1932. 366 pp.

The author suggests practical ways of adjusting the curriculum to the present social scene.

Lyon, Leverett S., Making a Living. The Macmillan Company, New York, 1932. 622 pp.

Designates the place of the individual in society. It is a logical and interesting treatment of vocations, business, civics, and the problems of community life.

Moon, Truman J., and Paul B. Mann, Biology for Beginners. Henry Holt and Company, New York, 1933. 741 pp.

One of the better textbooks for beginners, emphasizing the essentials of the drama of life and detailed enough to give a stimulating basis for queries about cause and effect.

Needham, James G., Outdoor Studies. American Book Company, New York, 1898. 90 pp.

A reading book of nature stories designed for the intermediate grades.

Newman, H. H., Editor, The Nature of the World and of Man. The University of Chicago Press, Chicago, 1927. 562 pp.

An outline of our knowledge of the physical and the biological world, and the position of man in the universe in which he lives. Written by sixteen professors of the University of Chicago.

Pearl, Raymond, The Biology of Population Growth. Alfred Knopf, New York, 1925. 260 pp.

The book is full of information which is discussed and shown in tables. It shows the outcome of a series of investigations by the author.

Reed, Chester A., Bird Guide. Doubleday, Doran and Company, Inc., Garden City, New York, 1931. 228 pp.

Land Birds East of the Rockies from Parrots to Bluebirds. All species are pictured and described.

Report of the Committee on Secondary School Studies. Government Printing Office, Washington, 1893. 249 pp.

This includes the famous report of the committee of ten as well as the reports of all the conferences arranged by this committee. The committee was appointed July 9, 1892, by the National Educational Association.

Robinson, W. W., Animals in the Sun. Harper and Brothers, New York, 1934. 56 pp.

About crocodiles, lizards, turtles, and snakes. Well illustrated.

Russell, Bertrand, Education and the Modern World. W. W. Norton and Company, Inc., New York, 1932. 245 pp.

An excellent treatment of the interrelationship of the social agencies of modern civilization.

Seymour, E. L. D., Editor, The Garden Encyclopedia. Wm. H. Wise and Company, New York, 1936. 1300 pp.

A complete, practical and convenient guide to every detail of gardening. Illustrated with 250 halftones and 500 line drawings.

Slosson, Edwin E., Creative Chemistry. Garden City Publishing Company, Inc., Garden City, New York, 1919. 311 pp.

Descriptive of recent achievements in the chemical industries. Tells in a most interesting way of the science that transforms matter. The biographies of the scientists who have made major contributions are worked into the narrative.

Smallwood, W. M., Ida L. Reveley, and Guy A. Bailey, New General Biology. Allyn and Bacon, Boston, 1929. 788 pp.

One of the best available textbooks for high school biology.

Storck, John, Man and Civilization. Harcourt, Brace and Company, New York, 1927. 449 pp.

A non-technical yet sufficiently dignified interpretation of human activity in fundamental agreement with the results of recent study in the fields of psychology, anthropology, and sociology.

Thompson, Arthur J., The Biology of Birds. Sidgwich and Jackson, Ltd., London, 1923. 436 pp.

Well illustrated and approached through such biological concepts as adaptation, struggle, sex, heredity, variation, selection, and behavior.

Walker, C. C., The Biology of Civilization. The Macmillan Company of Canada Limited, At St. Martin's House, Toronto, 1930. 323 pp.

Presents man as a struggling organism the same as all other forms of life on earth. The book treats in an interesting manner many of the aspects of civilization from the biological angle.

Webb, L. W., and others, editor, High School Curriculum Reorganization. The North Central Association of Colleges and Secondary Schools, Publication Office: Ann Arbor, Michigan, 1933. 395 pp.

An organized summary and interpretation of many tentative reports. Valuable suggestions for the reorganization and revision of materials for the various high school subjects. The book contains the materials developed by the Association's Committee on Standards for Use in the Reorganization of Secondary School Curricula, which has been working on its problems for more than twelve years.

Wells, H. G., Julian S. Huxley, and G. P. Wells, The Science of Life. The Literary Guild, New York, 1934. 1514 pp.

Interesting and thought provoking. The book is written in a semi-popular style. Authorative and full of facts.

Williams, John R., The Construction of an Objective Achievement Test in Biology for High School. Master's Thesis, K. S. T. C., Emporia, 1933. 73 pp.

The test is discussed with considerable evaluation of each of the questions.

Woodruff, Lorande Loss, Foundations of Biology. The Macmillan Company, New York, 1923. 476 pp.

A well organized and rather technical treatment of the entire field. The various branches of biology are nicely shown in their relation to one another and to science as a whole.

B. PERIODICAL ARTICLES

Hotz, H. G., "Five-year Trends in the Development of North Central Association High Schools, 1930-1935," The North Central Association Quarterly, 10:412-21, April, 1936.

McClellan, H. N., "Design for Curriculum," The Nation's Schools, 24:27-29, April, 1936.

Moore, Harry H., "Gangsters, Slums and Demagogues in Secondary Education," Progressive Education, 13:275-81, April, 1936.

Olson, William C., "Child-Teacher Relations are Experiencing a Shift in Emphasis," The Nation's Schools, 24:20-21, April, 1936.

"Shall We Discard the Family?" The Nation's Schools, 17:14-15, April, 1936.

Spohn, A. L., "Trends in Curriculum Changes, 1934-1935," The North Central Association Quarterly, 10:442-44, April, 1936.

Vinal, William G., "Nature Education, Social and Recreational," Recreation, 24:593-95, March, 1936.

A P P E N D I X

APPENDIX A

THE DEVELOPMENT OF BIOLOGY AS A UNIT SUBJECT

The Growth of the Subject--Increased Enrollment

Whether or not a subject is acceptable for college entrance is a vital influence upon the enrollment in it. Table I shows a comparison of science with some of the older standard subjects as a required subject for college entrance. Despite the fact that physics and chemistry are older established sciences in the high school curriculum for the purpose of meeting this demand for science, biology, the youngest of the group, has stepped to the front as the most popular science.

Table II shows a comparison of science enrollments in the North Central schools. The number of pupils involved makes it significant as an index for the entire nation. Interpreting the table, one may conclude that since biology reaches 15.2 per centum of the total enrollment yearly, over sixty per centum of the pupils are enrolled in the subject sometime during the four years they remain in high school. This is the only one of the sciences to reach over one-half of the pupils, as general science which ranks second, by applying the same supposition reaches exactly fifty per centum.

With such a great voluntary growth, it seems that biology has come to the place where it should be seriously considered as a possible curriculum constant. So recently has it gained this place of prominence, however, that the uniform transcript blank adopted by the National Association of

Secondary School Principals which is in use at the present time does not list biology.

The colleges, according to one nation wide survey tabulated in Table III, accept the various sciences in proportion to their respective ages. For example, of the 209 schools with lists of acceptable subjects, 208 of them include chemistry, 206 accept physics, but only 119 of them accept biology.

Those who come in closest contact with the curriculum surely see something worth-while in biology or it would not have enjoyed such phenomenal growth in the secondary schools.* The subject meets in a practical way many of the finer aims of education. Some of the more common aims are: (1) health instruction; (2) informational; (3) training in scientific thinking; (4) moral training; (5) sex education; (6) preparation for some vocation; (7) esthetic appreciation; and (8) leisure time activities.

> Biology has established itself in the secondary school's program of studies. In the past it has been looked upon by some teachers and specialists as a hodgepodge course, which made little worth-while contribution to secondary school pupils. Those specialists, however, who have some knowledge of the educational organon, and those teachers who realize the exploratory potentialities of biology, will see its immediate educational value for those students who go to college and still a greater value for those who do not. Biology will remain in their minds, and no doubt in practice, one of the most functional courses at the secondary-school level.[1]

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* See Table II, Appendix B.

[1] William E. Cole, The Teaching of Biology (D. Appleton-Century Company, New York, 1934), p. 31.

Another writer who is advocating biology as a requirement says:

> I am of the opinion that it would be a good thing to require biology as one of the basic sciences in our high schools, providing the social aspects of it are emphasized. There aren't many courses that lend themselves to the development of the socially worth-while aims as biology does. Also, since health statistics obtained during and after the war are convincing that personal hygiene needs to be stressed in our rising generation, it seems both feasible and economical to include human biology in the general biology course.[2]

Recent Trends in High School Biology

Since the world war there has been an ever increasing tendency to combine what was formerly the subject matter of botany and zoology into the broader subject of biology. As the subject matter of this new subject takes form, there is a constant enrichment of its scope until it now embraces many of the essentials of physiology, agriculture, and social problems. Biology is so vital and comprehensive that it lends itself readily to almost anything that arrests the concern of civilization. The resourceful teacher finds numerous avenues for approaching significant social problems consistent with the commonly accepted aims of education.

While the trend is toward a greater enrollment in the natural sciences, there is yet a great need for the teaching of more science that is directly related to the life problems of the pupils. Formal science is giving way to a more practical sort that recognizes the needs of the non-college as well as the college preparatory groups of students.

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[2] Lynda Weber, "Should Biology Be Required in High Schools?" School Science and Mathematics, 30:509, 1930.

What does it avail to know more about Cuvier and Maphigi than about juvenile delinquency in the adjoining city block; to sketch parasites on a fish if nearby streams are contaminated and fishless; to become skilled in identifying bacteria when Shanty Town is polluting the only stream in the neighborhood; to memorize formulae for amino acids when the nitrogen waste in the sewer is being locked up forever in the sea? Of what good is it to be supreme in laboratory technique if the human race within view of the conning tower of the biological table is one-hundred years belated? Why repeat classical experiments when new experiments are needed for social welfare?[3]

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[3] William G. Vinal, "Nature Education Social and Recreational," Recreation, 24:593-95, March, 1936.

APPENDIX B

TABLE I*

THE PERCENTAGE OF SCHOOLS REQUIRING SCIENCE FOR ENTRANCE COMPARED WITH THE PERCENTAGE FOR OTHER SUBJECTS

Region	Science	English	History and Civics	Languages	Mathematics
New England	30.0	100.0	80.0	100.0	100.0
Middle States	34.1	100.0	66.6	82.9	97.1
North Central	69.0	100.0	75.0	60.0	98.5
Southern	40.6	100.0	80.5	75.9	98.7
Western	81.8	100.0	83.3	72.2	100.0
Nation	55.5	100.0	76.6	72.1	98.0
Rank	5	1	3	4	2

Read table thus: In New England 30% of the colleges require some science as an entrance requirement, 100% require English, etc.

* William E. Cole, The Teaching of Biology (D. Appleton-Century Company, New York, 1934), p. 24.

TABLE II#

ENROLLMENT BY SUBJECTS, 1934-35 WITH PERCENTAGES OF TOTAL HIGH SCHOOL ENROLLMENT IN EACH SUBJECT (OF THE NORTH CENTRAL SCHOOLS)

	Enrollment in 1934-35			Percentage of Total Enrollments		
	Boys	Girls	Total	1925	1930	1935
General Science	88,591	74,699	163,290	11.5	12.4	12.5
Physical Geography	10,915	8,754	19,669	5.3	2.0	1.5
Biology	97,446	100,490	197,936	9.4	11.8	15.2
Zoology	8,774	6,984	15,758		1.3	1.2
Botany	8,332	10,915	19,247		1.9	1.5
Chemistry	75,211	46,615	121,826	8.8	8.8	9.3
Physics	71,665	20,843	92,508	8.5	7.6	7.1
Physiology	16,708	19,320	36,028		2.8	2.8

Read table thus: During the school year of 1934-35, 88,591 boys and 74,699 girls were enrolled in General Science. In 1925, 11.5% of the students in North Central Schools were enrolled in General Science; in 1930, 12.4% of the students were enrolled in General Science, etc.

H. G. Hotz, "Five-year Trends in the Development of North Central Association High Schools, 1930-1935," The North Central Association Quarterly, 10:4, April, 1936.

TABLE III*

THE NUMBER OF SCHOOLS ACCEPTING THE SCIENCES AS ENTRANCE UNITS

	Number of Schools	Number of Schools With Lists	Chemistry	Physics	Biology	Botany	Zoology	General Science	Physiology	Physical Geography	Commercial Geography	Astronomy	Geology	Agriculture
New England	20	19	19	19	15	14	10	5	4	11	1	1	1	0
Middle States	44	33	33	33	27	24	22	8	12	21	3	5	5	3
North Central	113	72	72	71	29	65	63	40	57	48	4	20	27	10
Southern	91	73	72	72	40	67	61	42	57	56	6	2	11	21
Western	22	12	12	11	8	10	10	7	8	8	0	0	1	4
Nation	290	209	208	206	119	180	166	100	138	144	14	28	45	38

Read table thus: In the New England States 20 colleges were investigated, 19 of these had college entrance lists, of which all 19 accept Chemistry, 19 accept Physics, 15 accept Biology, etc.

* William E. Cole, The Teaching of Biology (D. Appleton-Century Company, New York, 1934), p. 26.

APPENDIX C

ARRANGEMENT OF MATERIALS

Logical arrangement then has definite purposes and should not imply logic for the sake of science on the secondary-school level. To go from the lowest to the highest in zoology, for instance, requires that the pupil who pursues only one course in this subject--and the majority of pupils take only one course in the subject--spends so much time studying the "lowest" that he will not get to a point in one course where he will make any acquaintance with the "highest," although the highest may possess the most potential significance for him.

The advocates of logical arrangement of subject-matter in science also often aim at completeness of presentation of the subject rather than the selection of those phases of the subject-matter which are highly significant for the pupil.[4]

Content arrangement in biology should be logical in the sense that its various units or parts are as closely articulated as possible. Such articulation obviously makes for economy of learning by the pupil. Sometimes, however, what may appear on paper as an extremely illogical arrangement of subject-matter, may, in the hands of a skillful teacher, become a closely articulated course of study because the teacher succeeds in bringing about conditions and learning situations which will tie up closely with what appears to be inarticulated and remotely related phases of biological content. For example, a skilled teacher may be able to tie up the life function of plants and animals with any plant or animal, even though "life functions" are treated as a general specific unit.[5]

Where the project method of organization of subject-matter in biology is used, the best scheme seems to be to break up the course into several units with the various projects under each unit. The following illustrate the point:

UNIT I. THE HUMAN BODY

Project No.
1. Bacteria and their carriers.
2. Breathing.

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[4] Cole, op. cit., p. 62.

[5] Ibid., p. 63.

3. The organs of digestion.
4. The digestion of starch.
5. The passage of digested food into the blood.
6. The life stream of the body--the blood.
7. The circulation of the blood.
8. Removal of wastes from the human body.
9. The adequate disposal of sewage.
10. The care of wounds.
11. The individual pupil's health program.

UNIT II. THE FOOD WE EAT

Project No.

1. Sources of our foods.
2. The classification of foods.
3. The unit of measurement of the energy value of foods--the calorie.
4. Testing our foods for certain nutrients.
5. Testing foods for adulterations.
6. The biology of milk--why it spoils.
7. Care of milk in the home.
8. Common methods of preserving food.
9. Preservation of food by refrigeration and pasteurization.
10. Preservation of food by other means.[6]

Probably the best means of bringing about articulation between the various sciences in the secondary school will in the end be a modern scheme of curriculum-making which will follow the line of vertical, rather than horizontal development of the curriculum. That is, one unit of work in science, or in biology to be specific, should be based upon another in a continuous progressive fashion and in a way which will fill the gaps between each unit or subject. Each unit or subject, as the case may be, should have a fairly definite starting and stopping point, which should be well understood by the different science teachers in the system. This alone would prevent much of the repetition we have to-day in the secondary sciences.[7]

Let us relate some of these weaknesses or faults which are outstanding in laboratory work in biology:

1. Lack of purpose, or objectives, in laboratory work, and lack of recognition and explanation of objectives when present.
2. Slavish dependence upon outlines, manuals, syllabi, workbooks, etc., by both teacher and pupil.

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[6] Ibid., p. 67.

[7] Ibid., p. 74.

3. The tendency to teach laboratory work as subject-matter activity detached from the remainder of the course.

4. The performance of laboratory work, the results of which the pupils already know.

5. Requiring the pupils to do laboratory exercises or projects which have been selected on the basis of their adoptability to experimental procedure rather than on the basis of pupil interests or needs.

6. Loss of time in the biology laboratory due to poor planning, poor arrangement of the laboratory, insufficient apparatus, poor arrangement of equipment and materials, improper insight insight in assigning equipment to pupils, equipment out of repair, and the failure of the teacher to give pupils the necessary directions they need to have in order to follow the laboratory procedure effectively and without waste of time, and loss of effort.

7. Careless selection of projects, experiments or exercises.

8. Improper equipment and general lack of equipment and materials, even materials which are available locally and without cost.

9. Too much dependence upon dissection and drawing.

10. Teacher domination, and the tendency for many teachers to do too much work for the pupils.

The biology teacher should look upon outlines, manuals, syllabi, workbooks, and other articles of equipment as teaching aids, which should facilitate the pupils' learning and his own teaching, rather than ends within themselves.[8]

The high school curriculum, the committee decided, should be such as to produce in boys and girls the dispositions and abilities needed: (1) to maintain health and physical fitness; (2) to use leisure in right ways; (3) to sustain successfully certain definite social relationships, civic, domestic, community, and the like; and (4) to engage in exploratory-vocational and vocational activities.

Under each of these broad heads were then listed certain illustrative abilities and dispositions. These, the committee suggested, might easily be supplemented by many more drawn from the observation and experience of teachers or from the systematic analyses of educational and sociological investigators. By some such process long lists of detailed objectives would in time be secured, to serve as checks against the existing curricula, and to suggest what new materials may be added. It would be discovered in the course of these operations, the committee thought, that pupils had more life needs in

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[8] Ibid., p. 96.

common than the present amount of required work in the high school seems to recognize. These common needs must first be provided for, then differentiated group needs, and finally individual needs.[9]

Biological Theory

Actually biological theory consists of some ancient but not very easily stated truths about organisms in general, due largely to Aristotle, Hippocrates and Harvey, a few great principles such as those formulated by Darwin, Mayer, Claude Bernard, and Mendel, and a vast mass of facts about individual organisms and their parts which are still awaiting adequate generalization.[10]

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[9] L. W. Webb and others, editor, High School Curriculum Reorganization (The North Central Association, Ann Arbor, Michigan, 1933), p. 13.

[10] J. B. S. Haldane, Daedalus or Science and the Future (Kegan Paul, Trench, Trubner and Co., Ltd., Broadway House, London, 1924), p. 51.

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