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The Evolving Biology Textbook in Chicago Secondary Schools: From the Progressive Era to the Present

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THE EVOLVING BIOLOGY TEXTBOOK IN CHICAGO SECONDARY SCHOOLS:
FROM THE PROGRESSIVE ERA TO THE PRESENT

by

Addie Beatrice Cain

A Dissertation Submitted to the Faculty of the Graduate School
of Loyola University of Chicago in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Philosophy

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VITA

The author, Addie Beatrice Cain, is the daughter of Wesley Cain and Emma L. (Kennedy) Cain, now deceased. She was born September 28, 1934, in Chicago Illinois.

Her elementary and secondary education was obtained in the public schools of Chicago, Illinois. She was graduated from Wendell Phillips Elementary School in June, 1948 and Wendell Phillips High School in June, 1952.

In September, 1952 she enrolled at Herzl Junior College and received an Associate of Arts degree in January, 1955. That same year she entered DePaul University, and in August, 1958, received the degree of Bachelor of Science with a major in biology and a minor in medical technology. While enrolled at DePaul University, she did a one year internship in medical technology at Mount Sinai Hospital and Medical Center in 1956. Upon passing a national examination in medical technology she was admitted to the Registry of Medical Technologists of the American Society of Clinical Pathologists in 1957. In August, 1972 she was awarded the Master of Science in Natural Science from Chicago State University. In 1957 she began her career as a medical technologist at Mount Sinai Hospital. She remained there until 1960. From 1960 to 1966 she was employed as a bio-chemistry technologist at Mary Thompson Hospital. In the summer of 1966 she worked in the Head Start Program for the Chicago Board of Health. In 1967 she was employed as the supervisor of the clinical laboratory at the Woodlawn Child Health Center, University of Chicago. She remained there until 1974 where she started her teaching career at

Kennedy King College, where she is currently employed as an assistant professor of biology.

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Preface

The overall purpose of this study is to examine and identify trends in the teaching of biology as reflected by the textbooks used in Chicago Public Secondary Schools; specifically, those used from the progressive era (1890) to the present (1980s). In addition, an analysis was made to determine the extent to which social and educational trends have influenced these textbooks. The time period chosen, corresponds to the developmental stages listed by Schwab. Stage I--1890-1929: This stage was based on two factors: what was known about biology at the time and the supposed goals of the high school student. Stage II--1929-1957: This stage expanded and modified Schwab's earlier works. This modification included concerns for the diverse abilities, interests, background and intents of the high school student. Stage III--1957-Present: Schwab focused on the Biological Science Curriculum Study and included the relationship between the factors which he had previously outlined.¹

As a teacher of biology at one of the City Colleges of Chicago, the writer, during the course of doctoral studies, became interested in the historical evolution of secondary textbooks in biology. Specifically interest centered on those textbooks adopted by the Chicago Board of Education from the progressive era to the present.

¹Joseph J. Schwab, Supervisor, Biology Teachers' Handbook (New York: John Wiley and Sons, Inc., 1968), pp. 3-8.

This investigation began by searching the records at the Chicago Board of Education. A search for biology textbooks was made at the Center for Research Libraries, Midwest Inter-Library Center (book depository) and examined for educational and biological trends.

Educational trends were determined by examining commission reports, biology teacher's periodicals and teacher's manuals. These materials were obtained through inter-library loans. Chicago State University Library which was formerly Chicago Teachers' College provided additional materials sufficient to conduct this investigation.

In order to understand the context of this research, it seems imperative that a clear definition of at least two terms used in this study is appropriate.

Biology is the science that deals with organisms; it is the science of life in all its aspects - the study of form, function, and living habits of plants and animals. As a scientific endeavor, it is multifaceted. In a formal sense biology is a body of knowledge of life processes organized in a framework of broad unifying concepts. These concepts are developed from a point of view of understanding the nature of life in, and as related to, the entire universe. The phrase "from a point of view" suggests that biology is a way of looking at natural phenomena in limitless space and endless time.²

Progressive education: the designation of an educational movement

²Robert B. Platt and George K. Reid, Bioscience (New York: Reinhold Publishing Corp., 1967), p. 3.

that protested against formalism; arising in Europe and America during the last two decades of the nineteenth century, its extent was marked in 1919 by the formation of the Progressive Education Association; associated with the philosophy of John Dewey, it emphasizes commitment to the democratic idea, the importance of creative and purposeful activity, the real life needs of students and closer relations between school and community.³ Although Dewey influenced many progressive educators, not all progressives were advocates of Dewey's philosophy.

³Carter Good, Dictionary of Education (New York: McGraw Hill Book Co., Inc., 1973), p. 451.

CHAPTER I

INTRODUCTION

To a large extent, biology textbooks in American secondary schools reflect not only the content but also support the organization for many biology courses. They strongly influence the instructional presentation and testing procedures of the course. Whatever is new in curriculum theory and content reaches the majority of teachers and students by the way of the textbook. It appears that little or no research has been conducted to investigate, identify trends and analyze textbooks used in biology in the Chicago Public Secondary Schools, specifically from the progressive era to the present.

The history of science teaching in American Secondary Schools may be traced to Benjamin Franklin's Philadelphia Academy, founded in 1751. Descriptive and utilitarian aims formed this instruction. Natural history (biological science) and zoology as a part of geography were included in the course of study. Instruction emphasized the memorization of factual material but throughout the proposal for the Academy, practical educational experiences were stressed. Franklin advocated trips to nearby farms and actual practice in gardening as a part of the science program. He also recommended that students read the best natural histories. It was Franklin's hope to develop an education for practical living. His ideas reflected the relationship between education and his perception

of a future social order composed of "applied masters of living".

According to Voss and Brown, biological studies were offered in some of the better equipped academies as early as 1800. However, textbooks were few, and instruction centered on herbarium making (collecting dried, pressed plants and mounting them systematically for reference), memorizing text materials and classifying organisms. Zoology was taught from a natural history approach which was based on direct observations of specimens in their natural habitat (animal life - deer, rabbit, fox, etc.) to verify statements which appeared as facts in the textbooks.¹

In 1842 the work of Asa Gray had an impact on what was being presented in natural science textbooks. Gray, a professor of Botany at Harvard University, published a college text on plant analysis. The title of the textbook was How Plants Grow. This text influenced the change from the artificial classification system of Linneaus to the natural system.² The change came about slowly in the textbooks used in the secondary school but was well established after 1860. Changes in zoology were also influenced by Gray's work. Around 1875 there was a movement away from the natural history approach in zoology to one with an emphasis on animal morphology and studies of internal

¹Burton E. Voss and Stanley B. Brown, Biology as Inquiry: A Book of Teaching Methods (Saint Louis: The C.V. Mosby Co., 1968), p. 43.

²Linnaeus' system of classification was based on relationships of reproductive structures and is notable in that it was the first attempt to classify living organisms for their own sake, rather than to serve some utilitarian purpose. However, because it was based on the concept of "fixity of species" it did not include the characteristics which demonstrate natural or evolutionary relationships.

anatomy.³

With impetus from the idea of Charles Darwin and the theory of evolution by natural selection in 1859, the study of types that were representative of a given group of plants and animals became important. At that time, the concept of evolution was based on structural changes. If a plant or animal could be found with the characteristics by which a given group could be known, this was sufficient reason to study such a type. The botany and zoology courses then focused on the study of series of structural types. Scientific investigations were made in the laboratory of each type. Plant physiology was also included in the high school botany course at this time. By the end of the nineteenth century the laboratory approach to scientific inquiry based on the study of types and some plant physiology was generally well accepted.⁴ The laboratory approach was a learning situation in which activities carried out by pupils in a laboratory were devoted to the study of a particular subject. Earlier courses were primarily descriptive and were concerned with the recognition and classification of plants and animals.

Hurd found that the investigation on secondary biology textbooks by eighteen researchers were limited to analysis of content. Studies by Alford and Barakat also analyzed the content of biology textbooks. Levin and Lindbeck and Skoos focused on analyzing the content of these

³Voss and Brown, Biology as Inquiry: A Book of Teaching Methods, p. 43.

⁴Ibid., pp. 43-44.

issues. In his investigation, Howard did a comparative analysis of content and objectives.⁵

Schwab noted three developmental stages in the history of biology textbooks. In Stage I, from about 1890 to 1929, the basic model for the conventional textbook was laid down. This model was determined by two factors: first, what was known about the nature of life (biology) at the time; and second, the supposed goals of the high school student. In the second stage, from about 1929 to 1957, he pointed out that the earlier textbook was expanded but not fundamentally modified. The modifications were brought about by the concerns for the increasingly diverse abilities, interests, backgrounds and intentions

⁵For a discussion of these investigations see:

Paul De Hart Hurd, Biological Education in American Secondary Schools, 1890-1960 (Washington, D.C.: Curriculum Bulletin No. 1. American Institute of Biological Sciences, 1961), p. 195.

Donald W. Alford, "The Influence of the Biology Textbook (BSCS Yellow Version or Traditional) Used on the Success of Lufkin High School Graduates in College Zoology and Botany at Stephen F. Austin State University" (Ph.D. Dissertation, Texas A & M University, 1974).

Jack N. Barakat, "A Survey of the Content of Selected Biology Textbooks Used for Instruction in the Secondary Schools of Lebanon" (Ph.D. Dissertation, University of Missouri, 1961).

Florence Levin and Joy S. Lindbeck, "An Analysis of Selected Biology Textbooks for the Treatment of Controversial Issues and Bio-social Problems," Journal of Research in Science Teaching 16 (May 1979), pp. 199-203.

Gerald Skoos, "Topics of Evolution in Secondary Biology Textbooks: 1900-1977," Science Education 63 (October 1979), pp. 621-640; and

Cubie W. Howard, Jr., "A Comparative Analysis of the Objectives and Content of Biological Instruction in the Secondary Schools in Three Fields as Revealed by Representative Textbooks in the Field During Those Periods" (Ed.D. Dissertation, Indiana University, 1958).

of high school students. In the third stage, of which the Biological Curriculum Study was a part, two new developments took place: (1) the basic model was radically reordered and (2) the factors which determined the basic model and the modifications in Stage II were to show their relationship to each other.⁶

According to writers on the subject, the 1930s represented a time in education when attention was focused upon the individual student and his personal, social and economic welfare. Consequently, Voss and Brown noted, health education gained prominence in textbooks. Further, a report which reinforced the philosophy of this period was that of the Committee on the Function of Science in General Education established by the Progressive Education Association. The committee believed that students needed instruction in (1) personal living, (2) personal-social relations, (3) social civic relationships, and (4) economic relationships.⁷

In 1931, Osbourne reported that science teachers met to discuss ways and means of modernizing science teaching in the high schools. They agreed that extensive reorganization was necessary if the science work of the high school was to correspond with the principles of Progressive Education. They also concluded that the science work of the high schools needed to be integrated fully with the science taught in the elementary schools and with the instruction that followed at

⁶Joseph J. Schwab, Supervisor, Biology Teacher's Handbook (New York: John Wiley and Sons, Inc., 1968), pp. 3-8.

⁷Voss and Brown, Biology as Inquiry: A Book of Teaching Methods, pp. 46-47.

the college level. Further, the time allotment for science in the reconstructed high school should be increased if science was to make its full contribution to the development of rational living and securing on the part of pupils and understanding of science as a way of looking at life and enjoying it.⁸

In the forefront of the 1937 edition of Kinsey's Methods of Biology, the stated purposes were: "To Interest the Student in the World in Which He Lives, To Equip Him with the Scientific Method for Interpreting that World." The intent of his book, seemed to be clear. The author addressed himself, to the importance of textbooks. He noted that the organization of the biology course in the secondary schools depended largely upon the organization of the adopted texts. Further, he observed that it was probable that the books would continue to determine the content of the courses. Expressing his concern over adopted textbooks and their content he stated,

It has been said textbooks are sold not chosen. The sales arguments range from the state of the binding and the display of educational fads to bribes offered those responsible for city or state adoptions. The published records of the Federal Trade Commission are some indication of the extent of this practice.⁹

Then (1937) and now, as noted by Fitzgerald, the textbook is the dominant method of instruction.¹⁰

⁸Raymond W. Osborne, "Report of Group Conference on Modernizing Our Secondary School Science," Science Education 16 (October 1931), pp. 73-74.

⁹Alfred C. Kinsey, Methods in Biology (Chicago: J.B. Lippincott Company, 1937), pp. 89-90.

¹⁰Frances Fitzgerald, America Revisited: History Schoolbooks in the Twentieth Century (New York: Random House, 1979; Vintage Books, 1980), pp. 1-2.

In the early part of the 1940s the functional needs of students were stressed. Hurd noted that the objectives of science in general education were accepted, but that there were some changes in emphasis: (1) personal living (more on self realization); (2) personal-social relationships (i.e., on human relationships); (3) social-civic relationships (or more on civic responsibilities); (4) economic relationships (i.e., on economic efficiency).¹¹

World War II and the birth of the "Atomic Age" raised questions about the purposes of secondary school education as a whole and science teaching in particular. The movements in science education which began in the thirties were temporarily overshadowed by course adjustments made to meet "war time emergencies". New courses, such as pre-induction hygiene, nutrition and disease control were added to the biology curriculum.

A report entitled "Science Education in American Schools" was in the Forty-Sixth Yearbook, Part 1, of the National Society for the Study of Education in 1947. It listed the major objectives of science instruction as follows: (1) functional information; (2) functional concepts; (3) functional understanding of principles; (4) instrumental skills, measurement, manipulation, (5) problem-solving skills; (6) attitudes; (7) appreciations; and (8) interests.¹²

¹¹Paul De Hart Hurd, Biological Education in American Secondary Schools, 1890-1960 (Washington, D.C.: Curriculum Bulletin No. 1 American Institute of Biological Sciences, 1961).

¹²Victor Noll, Chairman, "Science Education in American Schools," Forty-Sixth Yearbook of the National Society for the Study of Education, Pt. 1 (Chicago: University of Chicago Press, 1947), pp. 25-26.

Loehwing pointed out, that although no one could predict the world order after the conflict of World War II, certain forces were already in motion that would have a profound influence on science instruction. In addition to the necessity for immediate restoration of veterans and war workers to civilian pursuits, there would be no new problems of educational policy arising from a politically and economically transformed world. He believed, the reconversion of industry from a "war footing" to a peace time basis would require considerable time. Young people would be encouraged to withdraw from a swollen labor market to return to school for several years. Post-war unemployment would encourage extended periods of education. As the period of training lengthened, the school's curricula would tend to supplement vocational training with increasing amounts of liberal and cultural education.¹³

For a variety of reasons, he continued, there would be a tremendous demand for biological instruction. Cessation of hostilities was usually the beginning of a great resurgence of interest in human values as opposed to the dominant technological and mechanized activity of war. The factors of human well-being are closely intertwined with plant and animal science, especially with their applications in agriculture and medicine. Likewise, there would be demands for world-wide service in agriculture and medicine; these services would require biological training. The place which science

¹³W.F. Loehwing, "Biology and the Plant Sciences in Post War Education," School Science and Mathematics 44 (June, 1944), pp. 496-497.

and biology assumed in the new educational order would be determined by new social needs and by the preparation of a comprehensive program of science instruction.

Tanner and Tanner noted that during the 1950s there were a number of curriculum reform attempts, particularly in the sciences and mathematics. The pressures of the Cold War and space race produced an initial reaction that called for academic excellence in schools. Less than a year following the launching of Sputnik I, a conference composed predominantly of scientists, mathematicians, and psychologists was convened at Woods Hole on Cape Cod in Massachusetts by the National Academy of Sciences. The outcome of that conference was a curriculum manifesto which was embodied in The Process of Education, authored by the conference chairman, Jerome Bruner.¹⁴ The Biological Science Curriculum Study (BSCS) was a response to this manifesto. The BSCS was a program developed to modernize the science curriculum and science teaching in the secondary schools. There were three primary objectives of the BSCS program: (1) to produce modern biology courses (textbooks) for the spectrum of students who take biology in high school; (2) to develop special resource materials for the teaching of these courses, such as films, pamphlets, laboratory blocks, equipment, tests, and new experiences; (3) to formulate programs and materials for both in-service and pre-service education of teachers so they may be better prepared to present the new

¹⁴Daniel Tanner and Laurel Tanner, Curriculum Development: Theory Into Practice (New York: Macmillan Publishing Co., Inc., 1975), pp. 404, 407.

biological course materials.¹⁵

Butts and Cremin, Hurd, and Voss and Brown agreed, the amount of biological knowledge was increasing at an accelerated speed. Further, it was no longer possible to "cover" a biological science course in high school, and it appeared equally improbable that the major principles could be adequately taught in the time available for a high school course. According to Hurd, the need for change in the science curriculum focused on the content of subjects, its up-to-dateness and usefulness for modern living, and whether the courses were being taught in an authentic "scientific" manner. Educators and the general public have recognized the inadequacy of old programs, realizing that they no longer served the needs of students, the public or the society, concern over these needs served to strengthen demands for change.¹⁶

Fitzgerald noted that in the nineteenth century, a heavy reliance on textbooks was the distinguishing mark of American education. They were substitutes for well-trained teachers and in some parts of the country they constituted the whole of a school's library and the only

¹⁵Weldon Beckner and Joe D. Cornett, The Secondary School Curriculum: Content and Structure (Scranton: Intext Educational Publishers, May, 1972), pp. 211-212.

¹⁶For a discussion of these concerns see:

R. Freeman Butts and Lawrence A. Cremin, A History of Education in American Culture (New York: Henry Holt and Company, 1953), pp. 510-511.

Hurd, Biological Education in American Secondary Schools, 1890-1960, pp. 1-11.

Voss and Brown, Biology as Inquiry: A Book of Teaching Methods, pp. 1-2.

book a child would ever read on a given subject. Although today textbooks must compete with other books, magazines and television, they seem to remain as the dominant means of instruction.¹⁷

In 1976, Fitzgerald continued, the National Science Foundation commissioned three studies on the status of science, mathematics and social studies education in the United States. On the basis of these studies some educators concluded: (a) the dominant instructional tool continued to be the conventional textbook and (b) teachers tended not only to rely on, but to believe in the textbook as the source of knowledge.

According to Shymansky, public support for science education declined during the Seventies and early months of 1982 when the Science Education Directorate or the National Science Foundation came close to extinction. Contributing to this demise of science education, he noted, was the perceived ineffectiveness of science programs developed with public monies in the sixties and early seventies. The general consensus was that the new science programs

¹⁷Fitzgerald, America Revisited: History Schoolbooks in the Twentieth Century, p. 19.

were a waste of money and were the cause of declines in student scores in science and mathematics throughout the seventies.¹⁸

Doyle, Director of Educational Policy Studies of the American Enterprise Institute, reported, textbooks were once again the subject of heated debate. Today he stated, "the issue is quality, yesterday it was patriotism, tomorrow it will be values". Like other writers on the subject, he acknowledged, textbooks are the source of most of the information acquired by students, shaping and defining the knowledge they will possess as adults.¹⁹

Ellis concluded, science teachers were finding they, along with others, were being involved in the revolution of affecting society. The United States, he pointed out, was in a rapid flux of change from an industrial society to an information society. A change was being called for in the foundation of science education. The focus on technology education represented a significant departure from past directions.²⁰

Science textbooks in the future will no doubt reflect the new focus of an information directed society. The research being undertaken by the writer will focus on the history of biology textbooks and examine the influence and impact societal trends made in the teaching of biology.

¹⁸James Shymansky, "BSCS Programs: Just How Effective Were They?" The American Biology Teacher 46 (January, 1984), p. 54.

¹⁹Denis P. Doyle, "The 'Unsacred' Texts: Market Forces That Work Too Well," American Educator 8 (Summer, 1984), p. 8.

²⁰James D. Ellis, "A Rationale for Using Computers in Science Education," The American Biology Teacher 46 (April, 1984), p. 200.

CHAPTER II

DEVELOPMENTS DURING THE PROGRESSIVE ERA: 1890-1929

Social and Educational Trends

During the late nineteenth century and early twentieth century there was a great deal of concern and controversy about the purposes and program of public high schools. The enrollment in the high schools had steadily increased and the curriculum had been expanded. These changes were related to the socio-economic changes that had produced industrial large cities like Chicago. Urbanization and industrialization required that people receive some kind of specialized, technical, or vocational instruction. Educators with a traditional view saw the high school as preparation for college. Those who were committed to a public tax-supported high school(s) saw it as preparation for life in an urban, industrial society.

These concerns were evident in Chicago. According to Herrick, they were a new factor in the life of the city and had a significant impact on the school and brought about changes in educational philosophies. The 1890s, she stated, saw increased pressures for change in the school along with population increases. Natural scientists wanted education to become a science, based on scientific principles. Business and industrial leaders wanted workers who had enough general background to adapt quickly to new enterprises. Further, psychologists described individual differences and

sociologists discussed the influence of the environment. John Dewey, Herrick continued, talked about the "whole child" and his need for concrete experience rather than abstractions and Jane Addams spoke for the youth on city streets.¹

Jane Addams, the founder of Hull Settlement House considered her program of "socialized education" a protest against a restricted view of the school. She opposed the elitist sentiment that perceived the underprivileged as having little to contribute to the spiritual life of the community. Further, the narrow-mindedness of educators with their limited view of culture, kept them from grasping the rich pedagogical possibilities in the productive life of the city. To become a force of social good, Addams believed the school would have to cast itself into the world of affairs, much as the Settlement House had done, and exert its influence toward the eventual humanizing of the productive system.²

Like Jane Addams and many others of his era, John Dewey wanted to promote order and social harmony. In The School and Society (1899), Dewey stated "whenever we have in mind the discussion of a new movement in education, it is necessary to take the broader or social view."³ Dewey emphasized both the individual and the society that

¹Mary J. Herrick, The Chicago Schools: A Social and Political History (Beverly Hills: Sage Publications Inc., 1971), pp. 81-82.

²Lawrence A. Cremin, The Transformation of the School: Progressivism in American Education, 1876-1957 (New York: Random House, Vintage Books, 1964), pp. 61-62.

³Sol Cohen, ed., "John Dewey on the New Education (1899)" in Education in the United States: A Documentary History, Vol. 4 (New York: Random House, 1974), p. 2219.

defined the individual. Dewey promised "when the school introduces and trains each child of society into membership within... an embryonic community life, saturating him with the spirit of service and providing him with the instruments of self direction, we all have the deepest and best guaranty of a larger society which is worthy, lovely and harmonious." Organization was the way to achieve economy and efficiency.⁴

Dewey's educational philosophy was founded on the Darwinian biological and social concepts of struggle for survival in a constantly renewing world. To him, intelligence was the method derived from experience to deal with the problems of life, and knowledge provides the auxillary tools needed in the operations of intelligence.

General Biological Trends

The conflict over the purpose of the high school led to the establishment of various committees to study and make recommendations about the course the high school curriculum should follow. Prominent among these was the 1893 Report of the National Education Association's Committee of Ten. This report had a significant impact on the secondary school curriculum and the organization of science courses in particular. The chairman of the committee and principal author of the Report was Charles W. Eliot, President of Harvard

⁴Erwin V. Johanningmer, Americans and Their Schools (Chicago: Rand McNally College Publishing Co., 1980), p. 240.

University, an influential leader in the NEA.⁵ These reports popularized the laboratory method as a means of making science teaching vital and effective. Habits of neatness and precision of expression were supposedly developed through keeping laboratory manuals.

The report included the recommendations of subcommittees in natural history, botany, zoology and physiology. The Natural History Committee proposed that instruction in botany and zoology begin in the first grade and be continuous in subsequent levels of elementary school instruction. A course of study organized around two units of instruction per year for eight years was outlined. No textbook was recommended.⁶

The Botany Committee recommended a year of instruction in botany organized around one lecture period, three laboratory periods, and one quiz period a week. The sequence outlined was: (1) Green slimes, (2) Green algae, (3) Brown algae, (4) Red algae, (5) Fungi, (6) Stoneworts; Chara or Nitella, (7) Bryophytes; liverworts and mosses, (8) Pteridophytes, (9) a gymnosperm, and (10) Phanerogams, Trillium and Capsella. An intensive study of each type of plant was recommended. Cell structure, development, reproduction, and life history were to be observed as student activities. When possible drawings of each type of plant were to be made.⁷

⁵U.S. Bureau of Education, Report of the Committee on Secondary School Studies (Washington, D.C.: Government Printing Office, 1893), p. 23.

⁶Burton E. Voss and Stanley B. Brown, Biology as Inquiry: A Book of Teaching Methods (Saint Louis: The C.V. Mosby Co., 1968), p. 44.

⁷Ibid.

The Zoology Committee proposed a year of zoology. The recommended time table of instruction was 200 hours, to be divided between 120 hours of laboratory work and 80 hours in reports on laboratory and textbook work. The committee suggested that the course begin with the intensive investigation of one animal, such as a goldfish. The following sequence was outlined: (1) Protozoa, (2) Porifera, (3) Colenterata, (4) Echinodermata, (5) Vermes, (6) Mollusca, (7) Arthropoda, (8) Insects (the grasshopper was recommended as a type; eight orders of insects were recommended), and (9) Vertebrates (a. fish, b. Batrachians; frogs and toads, c. Reptiles, d. Birds, e. Mammals; with some orientation toward man).⁸

The Physiology Committee recommended that hygiene be taught in the lower grades and physiology be placed in the secondary school curriculum. Further, the course of study should be experimentally oriented and include a semester each in anatomy, physiology, and hygiene.⁹

There were many reactions to and much debate about the Committee of Ten report. In 1898 a Science Committee initiated by the National Education Association issued a statement reacting to the reports. Voss and Brown have listed the following as major points in the Science Committee's statement:

1. All science courses should be two semesters in length; they should have definite laboratory periods of two

⁸Ibid.

⁹Ibid.

hours duration, offered twice a week with two periods for lecture and recitation. Science should be required for college admission.

2. "The minute anatomy of plants or animals, or specialized work of any kind, is premature and out of place in a high school course one year in length."
3. The course should be designed in the interest of students and should not be differentiated for those going to college or not.
4. Principles of biology should be studied.
5. A College Entrance Requirements Committee recommended that biology, botany and zoology be offered in the tenth grade. The course should meet at least four hours per week and carry one unit of credit.¹⁰

Additionally, this Committee urged that the taxonomic approach in high schools be discouraged. Their report stated that the taxonomic approach gave the student an exaggerated notion of the importance of structural parts for a limited group of animals and failed to develop biological concepts.

Hurd noted the following trends in biological education during this period (1890 to 1900) as follows:

1. The interest in continuous offering of biological science* from the first grade through high school.

¹⁰Voss and Brown, Biology as Inquiry: A Book of Teaching Methods, p. 45.

*Hurd used biological science terminology in his summary but most courses consisted of a semester each of botany and zoology or a year of botany or zoology.

2. The establishment of a required course in biological science at the tenth grade level.
3. The requirement of one year of biology for entrance into college.
4. The need for more uniformity of content in high school biology.
5. The teaching of biology as a laboratory science.
6. The need for an emphasis in biology teaching on the broader principles of the discipline.
7. The importance for all young people to receive instruction in hygiene and human physiology before completing high school.¹¹

Hurd also pointed out that a distinguishing characteristic of the 1890-1900 period in biological education was a shift away from a natural history approach to courses of "pure" botany and zoology with the major emphasis upon morphology.

The New York Board of Regents developed a course in biology in 1899. The course was a series of sub-courses in botany, zoology and physiology offered in a one year period. In 1907 George W. Hunter, a New York City high school teacher of biology, published a textbook called Elements of Biology which attempted to place the topics suggested by the Regents Syllabus into a connected form.¹²

¹¹Paul De Hart Hurd, Biological Education in American Secondary Schools, 1890-1960 (Washington, D.C.: Curriculum Bulletin No. 1. American Institute of Biological Sciences, 1961), p. 195.

¹²Ibid., p. 20.

The rapid growth of the number of pupils attending the secondary school who had no intention of continuing to college, stimulated curriculum makers and classroom teachers to experiment with courses in practical biology. It was assumed that biology for the citizen and biology for the potential specialist should be different in content.

In 1905 the Biology Committee of the Central Association of Science and Mathematics Teachers made the following recommendations for teaching high school biology:

1. There should be a full year of botany or zoology rather than a half year of each subject.
2. The work in biology should be preceded by an "elementary science" to familiarize the student with laboratory methods and to provide basic knowledge of chemistry and physics.
3. The course should meet six periods per week with double periods for laboratory or field work.
4. Botany and zoology should be acceptable to colleges as entrance requirements.¹³

It is interesting to note that as far back as the beginning of this century the importance of chemistry and physics in biological concepts was recognized.

In 1909 the High School Teachers Association of New York issued a report on the Practical or Applied use of Biology. According to the report the teaching of biology was going through a period of rapid transformation. Increased emphasis was being placed upon "training in

¹³Ibid., p. 19.

living" and upon "the practical use of the subject". This was similar to Franklin's ideas about the teaching of biology. With this view in mind the committee made the following recommendations for improvement of course content:

1. An economic phase - the preserving of natural resources.
2. A health phase - the relation of foods to efficient work of the animal body: the importance of pure foods and safe medicine; the cause and prevention of disease; the proper regulation of personal habits.
3. A cultural phase - development of an intellectual stimulus for a sympathetic interest in nature and the interrelationship of man and other beings; the proper conception of man's environment is a rare possession and this acquisition should be striven for.
4. A disciplinary phase - the habit of accurate thinking is a serious need in civilized life, and biology offers the data and method for making training of this kind effective; the only important mental discipline is that which is effective when applied to the problems of everyday life.¹⁴

The American Society of Zoologists argued that zoology should also have a place in the general education requirements of the high school. The proposed outline for a year's course of study can be seen in the following table:

¹⁴Ibid., p. 20.

TABLE 1
Zoology
Topic and Conceptual Approach

TOPIC	CONCEPT
1. Natural history	1. structure in relation to adaptations, life histories, geographical range, relations of plants to animals.
2. Classification of animals	2. phyla and leading classes in cases of insects and vertebrates
3. General plan of external and internal structure	3. one vertebrate (fish or frog) in comparison with the human body; annelid, coelenterate, protozoon
4. General physiology	4. comparisons of above types with human physiology and life processes in plants
5. Reproduction	5. "protozoon, hydroids, and the embryological development of the fish or frog"
6. Evidence of relationship	6. "suggesting evolution", a few facts on adaptation and variation
7. Optional	7. some epoch-making discoveries of biological history, the careers of eminent naturalists

Source: Hurd, Biological Education in American Secondary Schools, 1890-1960, p. 21.

The society of zoologists stressed the need for a good textbook and laboratory facilities. Two thirds of the courses, they stated, should be devoted to laboratory and notebook work. The notebook should be submitted at examination time with carefully labeled drawings of the main anatomical structures studied.

Hurd summarized the significant developments in biology teaching during the 1900-1910 decade as follows:

1. A growing commitment to a single course of general biology in the high school, integrating materials from botany, zoology and human physiology.
2. An awareness of the "average" student who will not continue into college and the desirability of developing for him a more practical (applied or economic) type of biology course.
3. The appearance of the first high school textbooks on biology intended to replace the separate texts of botany, zoology and human physiology.
4. The attempt to orient biology teaching toward biological principles, ideas and interrelationships.
5. More emphasis was given to the "scientific method" and the "practical" objectives for biology teaching.
6. The breakdown of the "mental discipline" theory in learning with more importance paid to capitalizing on student interests and experience.
7. The failure of human physiology to become established as a separate course in the curriculum; the enrollment in the course dropped almost 50 percent between 1900 and 1910.¹⁵

Developments in biology teaching from 1910-1920 reflected suggestions made by earlier committees and a rethinking of basic

¹⁵Ibid.

educational issues. In Democracy and Education (1916) John Dewey addressed himself directly to social efficiency as the aim of education. He suggested it was an appropriate aim if it promoted the active employment of the individual's abilities in socially significant activities and avoided what he termed "negative constraint" of individuals. Accordingly, it was entirely proper for schools in democratic society to teach youth to maintain and support themselves.¹⁶

In his address before the Biology Section of the Central Association of Science and Mathematics Teachers in 1915, W.L. Eikenberry observed that the question of what biology to teach is always with us. A re-examination of the pedagogical foundations of the present course of study, he stated, had made the question more acute than usual. So long as the schools appealed to but a single class of the population, he continued, the matter was comparatively simple, but the democratization of the high schools had brought about a situation such that pupils were no longer being trained primarily for college. The question of what type of biology should be taught was conditioned, therefore, not simply upon factors internal to the sciences concerned, but also upon the probable future occupations of the pupils and their stations in life.¹⁷

Most biology teachers, Eikenberry contended, would agree as to

¹⁶John Dewey, Democracy and Education (New York: The MacMillan Co., 1959), p. 139.

¹⁷W.L. Eikenberry, "A Popular Estimate of the Importance of Biology," School Science and Mathematics 16 (February, 1916), p. 152. Eikenberry's article was read before the Biology Section, Central Association Science and Mathematics Teachers, Harrison High School, Chicago, November 26, 1915.

the type of training which should be given to those who were college bound or entering biological research. There was no authoritative standard of instruction appropriate for the pupil who went directly from the city's economic and social organization. There could be no doubt, he continued, that the possession of certain biological information by the citizenry would be of great civic importance. For instance, he pointed out, if each of the citizens of Chicago possessed the knowledge of the germ theory of disease and its sanitary implications, the sanitary regulations of the city would reach a maximum of effectiveness.¹⁸

A report that had considerable impact on curriculum development during this period was that of the Commission on the Reorganization of Secondary Education (CRSE) in 1918 under the chairmanship of Clarence Kingsley. The Commission set forth its views as Seven Cardinal Principles of Secondary Education. These principles or statements of purposes were issued in a time when the United States was involved in World War I; when young men who were examined for military service, were found to have physical and educational deficiencies; when the last tides of immigration were diminishing; when industry was gearing for war, and when advancing industry was demanding specialized skills. It was a time when writers on the subject seemed to agree, that American families were feeling in earnest the tensions of industrialization. Emphasis was placed on social and environmental conditions, industrial medicine and placement of the physically

¹⁸ Ibid.

disabled. The Commission listed the following seven purposes of secondary education:

1. Health
2. Command of fundamental processes, that is, the fundamental or basic skills
3. Worthy home membership
4. Vocation, that is, the development of vocational skills
5. Citizenship
6. Worthy use of leisure time
7. Ethical character¹⁹

The report, like the Committee of Ten reports, reflected the move to study biology in its relation to human welfare: health, economic importance, sanitation, vocational aspects and appreciations.

Some educators tried to bend science to the life activities uses of the Cardinal Principles Report. In this, according to Krug, they followed the tradition made explicit by Herbert Spencer in his 1859 essay titled "What Knowledge Is of Most Worth?"²⁰ Spencer suggested that the standard classical curriculum of the nineteenth century was outdated and impractical. He believed, the purpose of education was "to prepare for complete living". He advocated that science has an important place in the curriculum because it was so useful in life.

¹⁹Commission on the Reorganization of Secondary Education. Cardinal Principles of Secondary Education (Washington, D.C.: United States Office of Education, Bulletin No. 35, 1918), pp. 11-16.

²⁰Edward A. Krug, The Shaping of the American High School:1920-1941, Vol. 2 (Madison: The University of Wisconsin Press, 1972), p. 100.

Spencer stressed the importance of formulating the educational program in accordance with the leading activities and needs of life, and he identified these needs in the following order of importance: (1) those activities which directly minister to self preservation; (2) those which secure the necessities of life; (3) those concerned with the rearing and disciplining of offspring; (4) those involved in the maintenance of proper social and political relations; and (5) those which make up the leisure part of life, devoted to the gratification of tastes and feelings.²¹ J. Lynn Barnard, director of social studies in the Pennsylvania State Department of Public Instruction, according to Krug, suggested that all subjects should make their contribution to citizenship. Barnard observed that "problems of race assimilation, of public health and sanitation, can be solved only in the light of biological laws, which are inescapable and universal in their nature and operation as are the laws of gravity."²²

Otis W. Caldwell, an educator at the Lincoln School of Teachers' College, New York, believed the general relation of science as a whole to the Cardinal Principles could be stated as follows:

It is important that those who are ill may be cured, but it is more important that people be so taught that they may not become ill. The control and elimination of disease, the provision of adequate hospital facilities and medical inspection, the maintenance of the public health, all necessitate widely disseminated knowledge and practice of these basic principles of hygiene and public sanitation. It is the duty of the secondary schools to provide such

²¹Herbert Spencer, "What Knowledge is Most Worth?" in Daniel Tanner, Secondary Education: Perspectives and Prospects (New York: The MacMillan Co., 1972), p. 91.

²²Krug, The Shaping of the American High School: 1920-1941, Vol. 2, p. 100.

instruction for all pupils. This purpose finds realization chiefly through science and civics. Therefore, health topics should be included in the science taught in the junior high school, and in at least the first two years of the four-year high schools.²³

Caldwell pointed out, that science touches the efficiency of the home and of life within the home at every angle. General science, biology and physiology, he believed all had definite services to render toward the proper organization, use and support of home life. Further, it was a serious criticism of science teaching these fundamental relationships had been largely overlooked.²⁴

Caldwell suggested that members of a democratic society needed a far greater appreciation of the part which scientifically trained men and women should perform in advancing the welfare of society. Science he thought, should therefore be especially valuable in the field of citizenship because of the increased respect which the citizen should have for the expert, and should increase his ability to select experts wisely for positions requiring expert knowledge. Science study should also assist in the development of ethical character by establishing a more adequate conception of truth and a confidence in the laws of cause and effect. Additionally, scientific instruction should contribute to vocational guidance, and be of direct assistance in the wise selection of a vocation. Such knowledge should impress students selecting certain vocations with the importance of making thorough and

²⁵Otis W. Caldwell, "Contribution of Biological Sciences to Universal Secondary Education," School Science and Mathematics (February, 1921), p. 107.

²⁴Ibid.

adequate preparation for their life work.²⁵

The 1920s, however, witnessed a rapid rise of the unified subject of "biology" which attempted to cover in an introductory way, the entire field of biology including psychology. The various textbooks on the market were divided into three parts - animal biology, plant biology and human biology.²⁶

Gradually, biology as related to the betterment of the environment of man entered the textbooks. Developments in medicine, hygiene, and sanitation (e.g. yellow fever) and applications of laws of heredity to eugenics and conservation (Theodore Roosevelt) were taught. To some writers on the subject, the directing force for this kind of information in biology came from the interest of the public and the teachers and not from university committees. Concurrent with the movement in applied (practical) biology was the changing high school population. Child labor laws, compulsory school attendance, and the vocational education movement concomitantly held and attracted more and different kinds of students to a high school education.²⁷

As science education moved into the twentieth century, a strong utilitarian motive was evident in such developments as the rise of a civic biology course, sometimes called "toothbrush biology", which was oriented toward improving unsanitary and poor health conditions of

²⁵Ibid., pp. 108-109.

²⁶E.E. Bayles, "The Organization of the High School Biology Course," Science Education (January, 1931), p. 75.

²⁷Voss and Brown, Biology as Inquiry: A Book of Teaching Methods, p. 47.

that time. The growing industrialization encouraged changes such as that which was included in some biology courses, knowledge about industrial medicine. General science was developed to serve as an introduction to biology, botany, zoology and the other sciences to excite the interest of the students in new technological marvels.

The stock market crash of October, 1929 marked the start of a severe depression. Economic conditions grew increasingly worse. Unemployment increased, banks and businesses failed and factories closed. These conditions had an impact on the content selection for "new" programs in Biology education. The new programs and their emphasis will be discussed in the next chapter.

Biology Textbooks in Chicago

Worrall Whitney dated the beginning of biology in the high schools of Chicago with the introduction of the laboratory method. The subjects of botany and zoology had been taught in the schools for sometime before, but they were classroom studies without laboratories. Biology as a laboratory study was introduced in 1892. The subject was made a required study in the first year of the curriculum. The course was prepared by E.R. Boyer, a teacher at Englewood High School. The use of biology as a subject to be taught in the colleges and universities was still new at that time and was a novelty as a subject in the high school curriculum. Consequently, Boyer had no high school experience with the subject to help him in instituting the course. He patterned the course essentially after one which was being taught at Johns Hopkins University. The course consisted of lectures on a series, in evolutionary order, of types of animals and plants

representing the principal and most important groups. Laboratory work accompanied these lectures which were extensive but little attention was given to related forms of animals and plants. There was nothing else to guide Boyer and no textbook.²⁸

Boyer also wrote the lessons for the high school biology course of study, mimeographed them and supplied copies to each teacher who, in turn, prepared copies for the pupils. The course began with the crayfish because it was larger and easier for young inexperienced pupils to study. After a month or two with crustacea and insects the work went back to the amoeba and began the laboratory series of animal types. The first part of the year was devoted to animal studies and the second part to plants. The same process was repeated with plants beginning with plerococcus. Each segment was studied in detail, using three or four weeks on such types as the crayfish, frog and fern. Because there was no textbook available, the teacher had to supply the needed explanations and the additional information about other forms of each group with the aid of specimens collected in the Chicago area.²⁹

In 1893, the high schools in Chicago began to increase rapidly in attendance. It became difficult to supply the laboratories with the needed materials in the standard fashion. Some schools had to use regular classrooms for biology. This problem became increasingly acute when incoming freshmen were added to the rolls each year. To

²⁸Worrall Whitney, "History of Biology in the High Schools of Chicago," School Science and Mathematics 30 (January, 1930), pp. 148-149.

²⁹Ibid., pp. 149-150.

alleviate this problem biology was made a second year course. Some teachers of biology taught physiography, instead, which was substituted for the required biology course.³⁰

During this period biology was becoming more and more "pure" zoology and botany. This was accentuated when semesters replaced fall, winter and spring terms. Another movement made botany and zoology each a whole year subject. Most of the larger high schools adopted the whole year course of study plan which included separate laboratories and teachers for each subject. A half year of "advanced" work in each subject was made elective for the third year of high school.³¹

For several years the teachers of biology got along without a textbook because none was available. The need for a textbook, however, became more and more urgent as the teaching of the subject broadened to include more of the life relationships of living things and less of structure and anatomy. Recognizing this need, Boyer began a textbook of zoology, but school duties allowed little time for textbook writing. After taking a leave of absence for the purpose of writing the book, the task was further complicated when Boyer was appointed assistant to the superintendent of schools. Later, when he became assistant principal at Francis Parker School, the book was dropped. The school authorities asked the Appleton Publishing Company for help and Professor Coulter (John M. Coulter) and President

³⁰ Ibid., pp. 150-151.

³¹ Ibid.

Jordan (David Starr Jordan)³² were delegated the task of preparing a textbook. With no model to guide them on how to combine relations they each wrote two books, Plant Relations and Plant Structure, Animal Life and Animal Forms. A practical difficulty arose when the teachers came to use the books. All four were needed but the pupils could not be asked to buy so many books - four books for each subject to be used for one half year. This difficulty was solved when a committee of three teachers were assigned the task of combining the two books in each subject into one book. The new books were published as Plant Studies and Animal Studies. These texts were used for several years. In later years many biology textbooks were written by college professors, but these writers rarely kept pace with the evolution going on in the high schools. These texts were either seldom in advance over their predecessors or were unsuitable for various reasons.³³

Later a Biology Round Table, a discussion group of teachers, was organized by the teachers of biology. For a number of years the Round Table met monthly or semi-monthly to discuss, methods of teaching the subject, for the subject was unorganized and the teachers felt strongly that methods suitable for the college were not suited to the high school. Every three or four years the teachers rewrote the course of study for biology, and later for botany and zoology, after

³²Board of Education Proceedings, City of Chicago, July 12, 1899-June 27, 1900, pp. 486, 490.

³³Whitney, "History of Biology in the High Schools of Chicago."

much discussion first in committees and then in the Whole Round Table. Later with the division of biology into distinct courses of botany and zoology, through committees of teachers, new laboratory manuals were written and published.

A Health and General Science course offered in the Chicago Secondary Schools in 1923 reflected the influence of the Commission on the Reorganization of Secondary Education Report. The major criteria which was considered can be seen in the following two tables:

TABLE 2

Interest in Phenomena and Applications of Science

PHENOMENA	APPLICATION
1. The city, earth, air, water and rocks	1. activity in home, industry and community - ex: simple machines, electrical appliances, heating and lighting devices
2. Living processes and activities - emphasis on human phases	2. operation, construction, dissection and expression in various forms
3. The strange, unusual and/or wonderful	3. the social or civic problems involving science
4. Discovery or invention	4. "man-sized" material and applications
5. Historical, biographical or "romantic" phase of discovery	

Source: Health and General Science (Chicago: Board of Education, Bureau of Libraries, Microfiche, 1923).

TABLE 3

Knowledge of Science Which has a Positive Value

KNOWLEDGE	VALUE
1. Communication, transportation, water supply, sewage disposal, pure food, fire prevention, fuel and soil conservation	1. health, personal and community
2. vocational, direct and choice	2. home applications - heating, lighting, power and water control devices
3. vocational - ex: collection, construction, photography, home experimentation, gardening, agricultural projects	3. industrial applications - ex: fuels, building materials, machines and power
4. food, water, air, fuels, building materials and clothing	4. essential materials for life

Source: Health and General Science (Chicago: Board of Education, Bureau of Libraries, Microfiche, 1923)

This course incorporated a utilitarian approach to biology and the other natural sciences. Up to this point and well into the 1930s instruction in biological science in Chicago secondary schools was presented for the most part as the separate sciences of botany, zoology, and physiology.

On February 27, 1929 the Chicago Board of Education adopted two supplements provided by the Bureau of Curriculum: A Course of Study in Botany for Senior High Schools and A Course of Study in Zoology for

Senior High Schools.³⁴

In the foreword of these supplements, William J. Bogan, the Superintendent of Schools, addressed himself to the values of science study. The aims of these courses he believed, were to develop a scientific habit of thought; that is, of demanding valid evidence before accepting general statements as true; to develop habits of orderliness and accuracy; an attitude of an open mind to new ideas and less subject to prejudice; an ability to base thoughts and actions on the results of individual reasoning and less upon traditional action of the consensus of opinions of a group; a working knowledge and understanding of the fundamentals of science; the relations of science to life and its environment with special emphasis on its common applications to our physical and social welfare. The units of work in these supplements were presented as topics to be discussed and investigated.

The sequence of units and aims for the course of study in Botany can be seen in the following table:

³⁴Bureau of Curriculum, Chicago Public Schools Bulletin S-b. A Course of Study in Botany for Senior High Schools (Chicago: Board of Education, 1929) and Bureau of Curriculum, Chicago Public Schools Bulletin S-z. A Course of Study in Zoology for Senior High Schools (Chicago: Board of Education, 1929).

TABLE 4

Course of Study: Botany

UNIT	AIMS
I. How Plants Obtain Such Complete Possession of the Earth Surface	<ol style="list-style-type: none"> 1. To develop an understanding of the supremacy of plants. 2. To develop a knowledge that plants are living things that compete with other living things.
II. How Man May Utilize Plants to Beautify His Surroundings	<ol style="list-style-type: none"> 1. To develop an understanding of the principles of choosing. 2. To gain knowledge that will lead to the desire to beautify homes and surroundings.
III. How Plants are Classified	<ol style="list-style-type: none"> 1. To develop an understanding of the principles of classification. 2. To gain knowledge that plants are numerous and varied in nature.
IV. How Seed Plants Obtain and Use Their Food	<ol style="list-style-type: none"> 1. To develop an understanding of the process by which plants obtain raw materials and make food. 2. To gain knowledge of plant structure and function.
V. How A Young Seed Plant Begins Its Growth	<ol style="list-style-type: none"> 1. To develop an appreciation of the growth process. 2. To develop an appreciation of the meaning of the seed in the life of the plant.
VI. How Non-Green Plants Live	<ol style="list-style-type: none"> 1. To develop an understanding of the effects of food dependence. 2. To gain knowledge of the useful and harmful work of non-green plants.

Table 4 (continued)

UNIT	AIMS
VII. How Plants Develop From Simple Forms	<ol style="list-style-type: none"> 1. To develop an understanding of the complexity of plant structure. 2. To gain knowledge of the complexity of plant structure from the lowest to higher forms.
VIII. How Man Utilizes Plants and Their Products For His Own Good	<ol style="list-style-type: none"> 1. To develop an appreciation of the important place of plants in the lives of mankind. 2. To develop familiarity with the economic uses of plants.
IX. How Man Improves and Increases the Products of Useful Plants	<ol style="list-style-type: none"> 1. To develop familiarity with the purpose and methods of plant breeding. 2. To develop an appreciation of Man's Control over plants. 3. To develop an appreciation of the work of plant breeders. 4. To gain knowledge of application of the scientific method of problem solving.
X. How Some of the Big Problems of Existence Are Met by Seed Plants	<ol style="list-style-type: none"> 1. To develop an understanding of the factors affecting reproduction and growth. 2. To gain a knowledge of flower parts and their relation to reproduction. 3. To develop skill in analysis. 4. To gain knowledge of environmental factors affecting reproduction and growth.

Source: Bureau of Curriculum, Chicago Public Schools, Bulletin S-b. A Course of Study in Botany for Senior High Schools (Chicago: Chicago Board of Education, 1929), pp. 10-33.

The sequence of units for the Course of Study in Zoology were as follows:

1. Relation of Insects to Man's Welfare
2. Principles of Classification
3. The Cell as Unit of Life
4. Result of Specialization in Structure
5. Animal Association
6. Relation to Animals to Their Environment
7. Life History of Vertebrates
8. Special Adaptations
9. Control of Animals by Man
10. Man and His Responsibilities to Nature
11. Changes in Animal Forms
12. Progress in Biology³⁵

The specific aims of units 7 through 12 were stated as follows: "Until recently, biology was not considered science because the method used in biology was speculation in insufficient data and made but the slightest progress."³⁶

The Basic requirements for these units included:

A. Age of Speculation

The great volume and wide distribution of biological material caused retardation of organized study.

³⁵Bureau of Curriculum, Bulletin S-z, A Course of Study in Zoology for Senior High Schools, pp. 7-34.

³⁶Ibid., p. 22.

B. Scientific Method of Study

1. Classification

2. Microscope

3. Relation to Chemical laws to life phenomena.

C. Work of Leaders of Biological Progress.³⁷

The aim of unit 12, Progress in Biology, was to give the student an appreciation of the influence that accomplishments of leaders in biological research have had upon world progress. The work of leaders to be discussed and the progress being made was detailed as follows:

1. Harvey proved the circulation of the blood by physics.
2. Darwin introduced the idea of collecting much data and science started to make progress.
3. Pasteur, by his final establishment that all life must come from some existing life; laid the foundation for aseptic medicine and surgery.
4. Experimental methods of Mendel and de Viries placed biology on a footing with the older sciences as a true science. These lead to the improvement of plants and animals used by man.
5. Plant and Animal breeding is helping to solve man's food problems. Eugenics aim at race betterment by the elimination of the unfit and the transmission of desirable traits.³⁸

³⁷Ibid.

³⁸Ibid., p. 33.

The textbooks adopted by the Board of Education during the period 1890-1928 show the movement towards a general biology course. The specialized courses in botany, zoology and physiology had emerged from a kind of general biology course known as "natural history". This course usually covered all in nature that could be filed under any one of the three fundamental categories: animal, vegetable, or mineral. The general biology course (textbook) that evolved focused on living things and their social and economic importance.

Textbooks Adopted by the Board of Education During the Period
1890-1928 with Specific Reference to Biology Education

TABLE 5

Textbooks Adopted for Use During the Period 1890-1899

Name of Text	Year First Adopted
Gray, Asa, <u>Botany</u>	1881
Tenney, <u>Elements of Zoology</u>	1881
Hutchison, <u>Physiology and Hygiene</u>	1883
Gray, Asa, <u>Manual of Botany</u>	1883
Packard, <u>Zoology</u>	1883
Carpenter, <u>Physiology</u>	1883
Boyer, <u>Laboratory Manual in Elementary Biology</u>	1893
Donohue and Henneberry, <u>Biological Tablet</u>	1893
Gray, Asa, <u>School and Field Botany</u>	1894
Armstrong and Norton, <u>Laboratory Manual</u>	1894
Jordan, David Starr, <u>Animal Life</u>	1899
Coulter, John M., <u>Plant Studies</u>	1899

Source: Board Proceedings, 8-21-1899-7-9-1890, p. 77; 9-1880-9-1881, p. 172; 9-1882-9-1883, p. 161; 7-6-1892-7-5-1893, pp. 127, 145, 205; 7-9-1893-6-26-1894, pp. 54, 516-517; 7-12-1899-6-27-1900, pp. 535, 538.

The textbooks used in Chicago Secondary Schools in 1890 were those that had been adopted during the period 1880-1890. These textbooks reflected the move away from the natural history approach to courses in botany, zoology and physiology. This period also saw the development of the laboratory manual in biology teaching.

During the period 1900-1920, the separate subjects of botany, zoology and physiology continued to be offered in Chicago's Secondary Schools. Some changes, however, were made in the list of textbooks authorized for use.

On August 31, 1910 the Committee on School Management reported that it was in receipt of a recommendation from the Superintendent of Schools, Ella Flagg Young that Tracey's Anatomy, Physiology and Hygiene be dropped from the list of textbooks authorized for use in the high schools and that Ritchie's Physiology and Sanitation, published by the World Book Company be adopted for use in the first year of high school.³⁹

Following the school year 1911-1912, Young recommended that the following textbooks be exclusively adopted and placed on the authorized list submitted to the Board on January 24, 1912: (1) Linville and Kelly, Textbook in General Zoology, Ginn and Co., publishers and (2) Whitney, Lucas, Shinn and Smallwood, Guide to the Study of Animals, D.C. Heath and Co., publishers.⁴⁰ See Table 6 for the texts approved for the 1916-1917 academic school year.

³⁹Board Proceedings, July 13, 1910-June 28, 1911, p. 98. Since there was a recommendation to drop Tracey's text, it must have been in use.

⁴⁰Board Proceedings, July 12, 1911-June 26, 1912, p. 84.

TABLE 6

Textbooks Adopted for Use in the School Year 1910-1917

Textbook	Publisher	Date Adopted
First Year Science		
Ritchie, <u>Physiology and Sanitation</u>	World Book Co.	Aug. 21, 1910
Blount, R.E., <u>Physiology</u>	Row, Peterson and Co.	Aug. 30, 1916
Caldwell and Eikenberry, <u>General Science</u>	Ginn and Co.	July 19, 1916
Caldwell and Eikenberry, <u>General Science Manual</u>	Ginn and Co.	July 19, 1916
Second Year Science		
Linville and Kelley, <u>Textbook in General Zoology</u>	Ginn and Co.	Jan. 24, 1912
Whitney, Lucas, Shinn and Smallwood, <u>Guide to The Study of Animals</u>	D.C. Heath and Co.	Jan. 24, 1912
Bergen and Caldwell, <u>Practical Botany</u>	Ginn and Co.	Jan. 24, 1912
Coulter, <u>Plant Life and Plant Uses</u>	American Book Co.	Jan. 21, 1914

Source: Board Proceedings July 5, 1916-June 23, 1917, pp. 98, 142, 525, 661, 663, 696, 739.

In 1928 several textbooks appeared on the authorized list under the title of biology in addition to texts on elementary botany, zoology and physiology. The emphasis at this time was upon the teaching of biology for its importance to human welfare - vocations, health, sanitation, avocations, appreciations and understanding the

environment.

The Textbooks on the list reflected the growing emphasis upon the applied aspects of the biological sciences. Physiology came to mean human physiology and hygiene. Further, it had been recommended by most committees that botany and zoology be made more "practical" courses. With each succeeding decade the values to be gained from the study of biological sciences have been redefined. See Table 7 for a list of these textbooks.

TABLE 7

Authorized Basic Textbooks, 1928

General Science

Textbook	Publisher
Van Bus Kirk and Smith, <u>The Science of Everyday Life</u>	Houghton, Mifflin Co.
Hunter, G.W. and Whitman, <u>Civic Science in Home and Community</u>	American Book Co.
Webb and Didcoct, <u>Early Steps in Science</u>	D. Appleton and Co.
Piper and Beaucamp, <u>Everyday Problems in Science</u>	Scott Foresman and Co
Wood and Carpenter, <u>Our Environment</u>	Allyn and Bacon

Botany

Coulter, <u>Elementary Studies in Botany</u>	D. Appleton and Co.
Poole and Evans, <u>First Course in Botany</u>	Ginn and Co.
Transeau, <u>General Botany</u>	World Book Co.
Bergen and Caldwell, <u>Practical Botany</u>	Ginn and Co.
Robbins, <u>Principles of Plant Growth</u>	John Wiley and Sons Inc.

Table 7 (continued)

 Zoology

Kinsey, <u>An Introduction to Biology</u>	J.B. Lippincott Co.
Hegner, <u>Practical Zoology</u>	The MacMillan Co.
Linville and Kelley, <u>General Zoology</u>	Ginn and Co.

 Biology

Hunter, <u>A New Civic Biology</u>	American Book Co.
Atwood, <u>Biology</u>	Chicago Medical Book Co., agents for P. Blakiston's Sons Co.
Peabody and Hunt, <u>Biology for Human</u>	The MacMillan Co.
Moon, <u>Biology for Beginners</u>	Henry Holt and Co.

 Laboratory Manuals

Whitney, Lucas, Shinn and Smallwood, <u>Study of Animals</u>	D.C. Heath and Co.
Kinsey, <u>Field and Laboratory Manual of Biology</u>	J.B. Lippincott and Co.
Hunter, <u>New Lab Problems in Civic Biology</u>	American Book Co.

 Human Physiology

Ritchie, <u>Sanitation and Physiology</u>	World Book Co.
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Source: Board Proceedings, July 3, 1928-Dec. 28, 1928, pp. 149-150.

Although a biology course had not been established in Chicago's secondary schools in 1928, textbooks in the "new science" (see Table 7) were on the authorized textbook list and would later help define the biology curriculum. The writer believes, George W. Hunter's text,

A New Civic Biology and William H. Atwoods', Biology were precursors to the proposed 1938 biology course in Chicago's secondary schools. The course was organized around a problematic approach which will be discussed and detailed in Chapter Three.

Both of the texts were organized around the separate biological sciences: botany, zoology and physiology. The textbooks were of the blended or general type which illustrated an effort to present biology as a science of living things. The last chapter of the books were devoted to great names in biology such as Darwin, Edwards, Lazear and Pasteur. Additionally, the texts were organized around important problems which involved experiments or activities. For an example, see Table 8.

TABLE 8
Problematic Approach to Biology

Topic	Laboratory Problem	Investigations
1. The Environment of Plants and Animals	1. To discover some of the factors of the environment of plants and animals	1. The environment of a plant 2. Environment of an animal 3. Home environment of a girl or boy

Source: Hunter, George W., Laboratory Problems in Civic Biology, pp. 3-4.

The textbooks included topics in taxonomy; morphology; natural history; ecology; health; heredity; appreciation; practical

practical application; physiology; and biologists and their contributions. Hunter's text (1914) placed most emphasis on in descending order: health, physiology and practical application. Atwood (1927) emphasized morphology, practical applications and appreciation. This difference may reflect the biological trend at the time of publication.

The text, Biology for Beginners by Truman J. Moon used a systematic approach to biology. It gave the student an opportunity to study a complete organism, plant or animal, by describing this organism as a complete entity. All life processes were described in their relationship to the function of the total organism. It is interesting to note that the topic, "Elements, The Alphabet of All Living Things" is included in this text. This suggests that Moon recognized the importance of the chemical basis of life. The text was like Hunter's and Atwood's in that it contained some of the same topics. The major emphasis was on morphology, physiology and health.

CHAPTER III

DEVELOPMENTS DURING THE PRE AND POST WORLD WAR II PERIOD: 1929-1957

Social and Educational Trends

The Great Depression of the 1930s caused our nation to reassess the role of school in society. It alerted the schools to the problems of youth. Although the "Cardinal Principles of Secondary Education" were published in 1918, they continued to provide the frame of reference for teaching. Many youth found themselves in the dilemma of being a burden to their families while remaining in school and being unable to find employment upon leaving school. It was estimated as of 1935 that four million, two hundred thousand youths between the ages of sixteen and twenty-four were unemployed.¹ Educators became increasingly aware of the need to study the problems of youth and to provide the means whereby youth might be better able to come to grips with these problems. A number of people looked to the educational system as one of the prime movers for building a better society.

According to some writers on the subject, progressive education had some successes during the depression. Some progressives believed that the confusion and demoralization following in the wake of the depression was the signal for turning attention to the schools and the

¹Sol Cohen (Ed.), Education in the United States: A Documentary History, Vol. 4 (New York: Random House, Inc., 1974), p. xxii.

education of the whole child. However, in 1932 George S. Counts, a Columbia Teachers' College professor, addressed the annual convention of the Progressive Education Association (PEA) on "Dare Progressive Education Be Progressive? Later, Counts combined the address with two others he delivered that year to form the pamphlet, Dare the School Build a New Social Order? Answering in the affirmative, he criticized the PEA for its emphasis on the individual and its lack of a social program. Counts called on the schools, especially the teachers, to reach for power in order for schools to become centers to reconstruct society. He urged teachers to organize in opposing privilege, and in opposing privilege, and indoctrinate according to his vision of society, a democratic collectivist blueprint.²

The problems of youth changed during World War II. But one legacy of the 1930s was a concern for those youth whom the high school had not reached - those who dropped out of school. The development of such programs governed educational discussions of the 1940s and was encouraged by the Educational Policies Commission of the National Education Association. The intentions of this group were expressed by the title of its 1944 publication: "Education For All American Youth", essentially a reformulation of the basic aims stated earlier as "The Cardinal Principles of Education". The functional needs of the students were stressed.

Following World War II, renewed interest in the ideas of John

²Gerald L. Gutek, The Educational Theory of George S. Counts (Ohio: Ohio State University Press, 1970), pp. 62-64.

Dewey and his followers culminated in a movement known as Education for Life Adjustment. It included a broadening of the high school curriculum to: (1) help students find satisfaction with themselves; (2) achieve an education which would better equip them to live democratically; and (3) benefit society as home members, workers and citizens.³ Originally intended for the 60 percent of high school age youth who it was asserted could not profit from college preparation training or from vocational training, it was soon extended to all youth of this age bracket. All subjects in the curriculum had to show how they contributed to Life Adjustment.

In the early 1950s a combination of social, political, and educational factors helped to dislodge Life-Adjustment Education. Included among these factors was the Russians' success in space exploration. This will be examined in Chapter Four.

General Biological Trends

The various committees on the study of education reporting during the pre and post World War II period took serious note of the past developments in science teaching, examined the practices and tried to develop a consistent theory of education in science. One of the most influential reports to be published during this period was made by the National Society for the Study of Education in 1932. The publication, "A Program for Teaching Science", presented information concerning curriculum theory and psychology of learning as related to science

³Life Adjustment Education for Every Youth, U.S. Office of Education, Federal Security Agency, Bulletin 1951, No. 22 (Washington, D.C.: Government Printing Office, 1951), p. 4.

teaching. The report proposed an organized and comprehensive program in science from the first through the twelfth grades. Its most significant contribution was its insistence that science instruction be organized around the major scientific generalizations or principles. In reference to biology teaching, the report affirmed the following: (1) children needed an understanding of biological principles and they needed practice in applying them to life situations; (2) the teaching of principles was the essential step in developing in the student a clear understanding of major generalizations; (3) the major principles must be developed by studying problematic situations; and (4) as much as four weeks of instruction should be required.⁴

A suggested list of biological principles common to the life needs of an average person included: The adaptation of organisms to their environment; the germ nature of disease; the interdependence of organisms; the cell as a structural and physiological unit of living things; the principle of evolution; and the distinctive characteristic of living things.⁵

In 1938 the PEA published a book which presented a comprehensive analysis of the contribution of science to broad areas of living. The report discussed many aspects of the teaching of science and claimed that adolescents needed instruction in personal living; personal-

⁴S. Ralph Powers (Chairman), "A Program for Teaching Science," Thirty-First Yearbook of the National Society for the Study of Education, pt. 1 (Bloomington, IL: Public School Publishing Co., 1932), pp. 224-26.

⁵Ibid.

social relationships; social-civic relationships; and economic relationships. Although general in tone and without detailed analysis of science in terms of typical school courses, it reinforced the educational philosophy of the period.⁶

The report of the Educational Policies Commission in 1944 pointed out that science could provide a cultural contribution. The report suggested that a basic course, "The Scientific View of the World and Man", should be taken by all students. This type of course reflected the social significance of science and probably received impetus from the impact of World War II.⁷

In 1945 a Harvard University Committee reporting in General Education in a Free Society, recommended that the teaching of high school science use broad integrative elements and scientific modes of inquiry set within cultural, historical and philosophical contexts. The stress was on the "lasting values" of scientific information and experience. In particular reference to biology, the report placed emphasis on the importance of studying the working of great biologists, such as Charles Darwin, William Harvey and Gregor Mendel. Projects and field experiences should parallel the work of the classrooms.⁸

⁶Progressive Education Association, Science in General Education (New York: Appleton Century Crofts, Inc., 1938), 591p.

⁷Educational Policies Commission. Education for All American Youth - A Further Look (Washington, D.C.: National Education Association, 1952), 382p.

⁸Report of the Harvard Committée, General Education in a Free Society (Cambridge: Harvard University Press, 1945), p. 153.

The Forty Sixth Year Book, Part 1, of the National Society for the Study of Education was published in 1947. It presented a view of science education with instructional objectives. It included: (1) functional information; (2) functional concepts; (3) functional understanding of principles; (4) instrumental skills, measurement, manipulation; (5) problem-solving skills; (6) attitudes; (7) appreciations; and (8) interest.⁹

The Yearbook's criteria for the selection of subject matter were as follows: In the first place, the statement of objectives should be practicable for the classroom teacher and usable for the student. Second, the statement should be psychologically sound and based on generally accepted principles of learning. Third, attainment of the objectives should be possible. Fourth, the selected objectives should be universal in a democratic society. Finally, the statement of objectives should indicate, directly or by implication, the relationships of classroom activity to desired changes in human behavior.¹⁰

The committees supported, to some degree, the importance of science in the maintenance of a "free society" based on democratic ideals. These goals could be met by developing an informed citizenry, schools would serve as the training ground for developing scientific manpower. These committees, however, did not closely define the

⁹Andrew D. Ripley, ed., "Science Education in American Schools," Forty-Sixth Yearbook of the National Society for the Study of Education, pt. 2 (Chicago: University of Chicago Press, 1947), pp. 25-26.

¹⁰Ibid., p. 25.

curriculum nor teaching procedures for reaching these goals.

Throughout the 1930s and 1940s, there was expressed concern over the focus of biology teaching. A report of the Committee on the Teaching of Biology of the Union of American Biological Societies in 1942 surveyed and analyzed results of a questionnaire on high school biology teaching. There were responses from 3,186 biology teachers. In regards to the curriculum, the teachers believed the greatest emphasis in general biology should be on the following topics: (1) health-disease, hygiene; (2) physiology; (3) heredity; (4) conservation; and (5) structure. The teachers gave the lowest rating, in terms of emphasis, to the following topics: (1) eugenics; (2) behavior; (3) scientific method; and (4) biological principles.¹¹

According to Fitzpatrick, a biology teacher at Brockton High School, Brockton, Massachusetts, teaching methods were subject to much criticism in 1939. The courses of study and whole curricula were the object of close scrutiny. Therefore, it seemed only natural to reflect on the matter of how to use the most common place tool with which the pupil was provided - the textbook. There seemed to be no question, from Fitzpatrick's view, about the difference in the makeup of the average high school biology class at that time. Classes were smaller in size and marked by a very different type of pupil. Many had left school and were absorbed in industry. Those who remained in school were characterized by a seriousness of purpose, and seemed to

¹¹Burton E. Voss and Stanley B. Brown, Biology as Inquiry: A Book of Teaching Methods (Saint Louis: The C.V. Mosby Co., 1968), p. 50.

know their purpose for being in school, and thus tackled their job in a manner more satisfying to the teacher and more profitable to themselves.¹²

Further, Fitzpatrick suggested using a textbook in the past did not present some of the difficulties which it did during the 1930s. For example, assignments were given, and pupils were expected to do them at home. Probably, the practice of the time was to return to school the next day and be prepared to participate in the discussion or recite the subject matter which had been assigned. Classes were small enough so that a teacher could have some reaction from every pupil; consequently, pupils who knew this prepared themselves accordingly.

In Fitzpatrick's opinion, classes were so large that it was impossible for a teacher to get a response from every pupil. In some cases, due to crowding of more subjects into the curriculum, the allotment of time was less per week. Most significant, however, was the change in the type of pupil. There were a large number of pupils who were not book minded and who could get very little from textbooks used in the traditional academic manner. More than ever, teachers had to keep in mind that they were teaching pupils first and subject matter second.

Fitzpatrick believed that one effective use of the biology textbook was to correlate it with the laboratory work as fully as possible. In doing so, the teacher would have the effective motivation which laboratory work usually supplied. Use of the text as

¹² Leo J. Fitzpatrick, "How Shall a High School Pupil Use a Biology Textbook," The American Biology Teacher 1 (February, 1939): 105.

a reference would help in clearing up misunderstandings in material which might otherwise necessitate personal explanation by the teacher. Use of workbooks correlating with the text would also be helpful. With workbooks there was the additional advantage of giving more individual attention. Workbooks and worksheets could secure greater pupil activity than was obtained by the old time recitation plan. Finally, biology was regarded as a cultural subject and much of the cultural side could come from reading the textbook rather than through a close check of factual knowledge.¹³

In essence, Fitzpatrick concluded that biology textbooks should be used to bring before students, whether beginners or more advanced, a selected body of facts and theories with their applications in the affairs of life. It should bring the essentials of the subject as they have been gained and evaluated by others. Its use should be such that these functions were accomplished and never through insistence on memory or failure to comprehend vocabulary.¹⁴

Bigler, a biology instructor at Sequoia Union High School in Redwood, California, suggested that before teachers of biology could deal with any phase of the relationship of biology to other sciences and to education as a whole, teachers had to clarify their thinking as to what their general ideal for education was. They had to ask themselves seriously what they were trying to do for their pupils. There was general agreement, according to Bigler, that teachers wanted to help their pupils to know how to live now and in the future and how

¹³Ibid., pp. 106-107.

¹⁴Ibid.

to become physically fit in order to be able to establish happy and wholesome social relationships. In addition, they would help students develop poise and assurance, because they could feel a security in their friendship, and thus place at their disposal a means of getting along happily in life.

Bigler believed that all classroom activities and discussions should be based upon the pupil's life. This would enable the students to understand their place in the general scheme, what they must do and what they must avoid doing in the continual "struggle for existence". She concluded that, you have a natural setting for a vital and fundamental interest.¹⁵

In addressing himself to the importance of biology teaching in the secondary schools, Sears expressed ecological and social concerns. He suggested that biology was the link between the physical and social sciences. Sears believed that students could come to understand the natural communities of plants and animals which, during the centuries, have shaped their own region for its present utility. Additionally, they could be made aware of the impact man has made upon these natural communities. Students would come to realize how the changes made by destroying forests, prairies, and wildlife, have impacted upon their economic life. In doing so they would be prepared to understand the task of building a new organic type of community if they were to

¹⁵Anne L. Bigler, "The Relationship of Biology to Other Sciences and to Education as a Whole," The American Biology Teacher 2 (October, 1939); 3-2.

survive.¹⁶

John Breukelman, an educator at Kansas State Teachers College, recognized that high school biology was characterized by an almost complete lack of standardization, in both aims and content. The aims were constant matters of controversy, among both biologists and educators. In content, no two textbooks or manuals were alike. Biology teachers were not in agreement on what ought to be included in the course and what should be left out.

Although there were many reasons for this diversity, four were outstanding. First, biology was a subject that must be adapted in a large measure to the locality in which it is taught. Second, its course organization had changed a great deal, ranging from botany, zoology, nature study, and natural history, to anatomy, physiology, hygiene, and health lessons. Third, since the general course was relatively new in the high schools it had not been subjected to the standardizing influences of the stricter college requirements of the past. Fourth, there had been very little organization of biology teachers into groups for discussion of common problems.¹⁷

Paul V. Beck, a teacher at Central High School in Tulsa, Oklahoma, pointed out that although changes were taking place in the organization of every science course in high school, there was no course that was organized on more different plans than biology. He

¹⁶Paul Sears, "The Importance of Biology Teaching for Secondary School Pupils," The American Biology Teacher 1 (January, 1939): 67.

¹⁷John Breukelman, "Some Aspects of High School Biology," The American Biology Teacher 2 (February, 1940): 107.

suggested that because of the newness of biology, as compared with physics and chemistry, the subject may not have sufficient time to find a generally accepted plan of organization. The writing of biology textbooks, Beck felt, had been a fertile field for those who wished to present their personal viewpoints. Consequently, there were about as many plans for organization as there were texts on the market. The biology course had come a long way from the early years when it consisted of one half year each of botany and zoology. It was the consensus of high school teachers that the biology course should have a unifying plan of organization rather than one separated into its compartments.¹⁸

Fowler noted that the Progressive Education Movement of the 1930s and 1940s added more prestige to the unit plan of instruction. Student-teaching planning became the vogue in classrooms where the teacher was a convert to the new philosophy of progressivism. Because the progressives believed in a student-centered curriculum, it became necessary to completely redesign biology classrooms with facilities for both the lecture-discussion method and the laboratory in a single classroom setting.¹⁹

During World War II, all teachers including biology instructors, were asked to respond to the call of patriotism. It was felt that those in biology, could best meet that call. H.W. Hochbaum, the

¹⁸ Paul V. Beck, "Our Changing Biology," Science Education 26 (January, 1942): 26.

¹⁹ H. Seymour Fowler, Secondary School Teaching Practices (New York: The Center for Applied Research in Education, Inc., 1964), p. 35.

Chairman of the Victory Garden Committee for the United States Department of Agriculture reported that the Victory Garden programs of 1943 were a success. The appeal made by the Secretary of Agriculture and other leaders for more food from home gardens was met with a tremendous patriotic response.²⁰

Hochbaum suggested that many more volunteers would be needed in 1944 to make a larger program succeed. He believed that school teachers could be a great help in the program. He asked the teachers to: (1) organize small local garden committees; (2) survey the local garden opportunities; (3) obtain support of local press; (4) hold garden meetings; (5) obtain help from the agricultural extension agents; (6) give demonstrations in preparing soil; and (7) provide instruction in harvesting vegetables, and handling food canning.²¹ Biology teachers across the country responded to this need. It will be noted in a later discussion how biology teachers in Chicago responded to the need during this period.

Zachariah Subarsky, a teacher at the Bronx High School of Science in New York, believed that the biology syllabus should be revised during the world upheaval. He thought that the course of study in biology should equip students with the practical understandings and skills needed to live effectively through the period of war and its aftermath. He developed a course of study that he believed would

²⁰H.W. Hochbaum, "Victory Gardens in 1944, How Teachers May Help," The American Biology Teacher 6 (February, 1944): 101.

²¹Ibid., pp. 102-103.

contribute toward making biology teaching more functional in the lives of students.²² His suggested syllabus can be seen in the appendix.

The atomic era and the subsequent swift rise of science technology after World War II helped lead to the origin of the National Science Foundation (NSF) in 1950. The NSF was authorized and directed by the Congress to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences. Keith Kelson, a member of the NSF, pointed out that whether we liked it or not, it was an unassailable fact that science and technology had become the hallmark of the era. Even more to the point they had become the very foundation of our own particular national way of life. Science was no longer a tranquil pursuit removed from everyday life. Its social impact, both realized and potential, was a matter of utmost importance. Further, it was particularly true in those days of international hostilities.²³

Several years after its creation, the NSF assumed major support for high school science curriculum innovation as a part of its overall mission. The National Association of Biology Teachers, with financial assistance from the NSF, initiated the first real effort toward exploring the biology course in the high schools. The Southeastern Conference and Biology Teaching in the Summer of 1954 and the North Central Conference in 1955 brought together professional biologists,

²²Zacharian Subarsky, "Biology Teaching in War Time - Some Suggestions," The American Biology Teacher 6 (November, 1943): 27.

²³Keith Kelson, "The National Science Foundation Program," The American Biology Teacher 17 (January, 1956): 66.

high school biology teachers, science education specialists, public school administrators, and state department officials to study the biology program. Major objectives recommended for the biology course were an understanding of: (1) the basic principles of biology course human life; (3) the organism and the physical environment; (4) how biology can be used in later life; (5) scientific methods and attitudes; (6) the positive approach to physical and mental health; and (7) avocational interests and appreciations related to living things.²⁴

Robert A. Bullington, an instructor of Biology at Northern Illinois University suggested in 1954 that to really discover what was being done by the biology teachers of the nation would require an extensive study - one on the order of a doctoral dissertation. Such a study had been conducted in 1949-1950 by Martin and was published by the U.S. Office of Education under the title The Teaching of General Biology in the Public High Schools of the United States. Bullington believed that this study would have great significance for secondary teachers of biology.²⁵

The study revealed that as part of the general education biology would be taught as preparation for life. Biology teachers would promote scientific projects such as Junior Academy exhibits. Audio visual aids had proven to be successful. Teachers had become aware of

²⁴Voss and Brown, Biology as Inquiry: A Book of Teaching Methods, p. 50.

²⁵Robert A. Bullington, "What's New in the Teaching of Biology," School Science and Mathematics 54 (April, 1954): 253-254.

progress in areas of research, for example, antibiotics, radioactive elements, cancer, and disease prevention. According to Bullington, the study concluded that teachers of general biology were focusing on current developments in the world in which they lived.²⁶ The observations noted by Bullington perhaps influenced some of the developments of the Biological Sciences Curriculum Study (BSCS).

The general ferment in biological education, the explosion of knowledge, the rise of molecular biology and advances in the psychology of learning, caused the American Institute of Biological Science to form a committee on education. Its charge was to study education in the biological sciences. The Biological Sciences Curriculum Study was organized by the committee (See Chapter 4).

The Depression years produced a period of questioning of educational practices that characterized a time of economic crisis. The "Consumer Science" was developed for the purpose of helping students become more intelligent purchasers of goods and services. The committees reporting on science teaching in the decades of the thirties, examined current practices and then sought to develop a consistent theory of education in science. From 1940 to 1950, World War II and the birth of the "atomic age" raised questions about the purposes of science teaching. "Air age" biology which came into being during the war years quickly yielded to a concern for the technical manpower needs of the 1950s. The modern period in science education

²⁶Ibid.

may be said to have begun with the concern for technical manpower needs of the 1950s which was accelerated by Russia's orbiting the first man-made satellite in 1957.

Biological Trends in Chicago Secondary Schools

By the end of the 1936 school year every freshman in the Chicago Public High Schools was required to study general science. The course was an extension of the junior high school program and was designed for the general education and orientation of all students. The aim of the course was to learn the nature of the science procedure or the "scientific method of investigation". Experimental work of the simplest type centered around problems the student met in the home, such as those connected with food, water supply, clothing, healthy, sanitation, and disease. The biological portion of the course was offered principally in the second year. It included topics in botany, zoology and physiology.²⁷

Keeping pace with the new (modern) trends in education, in 1937 the Chicago school system established a Bureau of Curriculum to build and revise courses of study. The new courses were based on experimentation and research by teachers in various fields. For the sciences the bureau selected two areas of study. First there was general science. This course outlined the work of science and was required of all students in the first year of high school. It was developed to serve as an introduction to biology, physics and

²⁷ Annual Report of the Superintendent of Schools, City of Chicago 1936-1937 (Chicago: Board of Education, Bureau of Libraries), pp. 143-144.

chemistry and to stimulate the students' curiosity about the technological marvels of the time. The course included a selection of problems for investigation and suggested in a general way how they could be presented. The second was biology which was designed to replace the previous courses in botany and zoology. The instructional material was arranged in closely integrated units which were intended to give the pupil an opportunity to understand and interpret phenomena of the living world, and to see the relationship of animal and plant life to human life.²⁸

For the 1938 fall semester a course of study in Biology I was prepared by Idrom P. Daniel, a member of Chicago's Research Staff of the Bureau of Curriculum. The intent of the course can be understood from Daniel's introduction:

The course of study in the Chicago Public High Schools should give the pupil the opportunity to satisfy his [sic] natural desire to understand and interpret phenomena of the living world. It should bring him [sic] in actual contact with living things in the laboratory, home, and field so that he may observe their characteristics and watch them develop, reproduce, and respond to natural forces. Its activities should be the kind from which intelligent understandings may in turn be molded into principles that are interwoven into human relationships. Such a course should contribute to life enrichment.²⁹

The major educational objectives and unifying biological principles for the course can be seen in Table 9. The objectives served as hypotheses by means of which the teacher could make

²⁸Annual Report of the Superintendent of Schools, City of Chicago 1937-1938 (Chicago: Board of Education, Bureau of Libraries), p. 126.

²⁹Ildrom P. Daniel, Course of Study Fall Semester Biology I, 1938 (Chicago: Board of Education, Bureau of Libraries, Microfiche, 1938).

Table 9
 Biology I Course
 Fall Semester, 1938
 Chicago Secondary Schools

Objectives	Biological Principles
1. The development of understandings of the important biological principles which are needed most frequently in the solutions of problems of everyday life.	1. The interdependence of organisms. 2. The germ nature of disease.
2. The establishment of certain scientific attitudes exemplified in the work of great biologists.	3. The theory of evolution.
3. The development of a reasonable degree of skill in scientific thinking.	4. The Cell as a structural and physiological unit of living things.
4. The provision of a wide variety of experiences for a worthy use of leisure time.	5. The adaptation of organisms to their environment.
5. The development of worthwhile and interesting acquaintances with living things.	6. The distinctive characteristics of living things.

Source: I. Daniel, Course of Study Fall Semester Biology I, 1938
 (Chicago: Board of Education, Bureau of Libraries, Microfiche, 1938).

decisions about the curriculum, its organization and the selection of teaching procedures. The instructional material was arranged in nine unifying units based on facts pertaining to biological principle. The principles were taken from "A Program for Teaching Science" in the Thirty-First Yearbook of the National Society for the Study of Education.

Daniel chose the unit plan of instruction as the method of teaching because he believed it would provide an excellent opportunity for meeting individual differences in students and would give training in the scientific method of thinking. In order to provide for individual differences, a wide variety of activities of considerable range of difficulty were included in the solution of each problem. No pupil was expected to perform all of activities in order or to solve all of the problems. The teacher had to discover the needs, interests, and abilities of each pupil and make that assignment accordingly. The pupil was to be challenged to the peak of his ability.

The unit plan of teaching (developed in the 1920s) was designed to include not only the content of the unit but also exercises, experiments, and tests. The table of contents for this course (Table 10) shows that it was a principles course or as it is sometimes called, a conceptual schemes course. In this type of course, facts are those elements in a situation gained from observation; a series of those related concepts make up a conceptual scheme. The group of conceptual themes or principles, help describe the biological world of the student.

Table 10

Table of Contents Biology I

Unit Number and Major Problem	Sub Problems for Unit
<p>I. What Interesting Features of the Living World are Revealed with Autumn. (Activities: (1) study the structure, function and main parts of the grasshopper; (2) compare grasshoppers with other insects; (3) study different species; and (4) watch living grasshoppers eat, describe food it eats and mouth parts.)</p>	<ol style="list-style-type: none"> 1. What are the relations of insects to human affairs? 2. What are the relations of weeds and fall flowers to human affairs? 3. What are the relations of trees to human affairs?
<p>II. How Is The Living World Orgaznized Into Groups?</p>	<ol style="list-style-type: none"> 1. What does classifying living things mean? 2. What are the characteristics of certain members of the animal phyla? 3. What are the characteristics of the plant group?
<p>III. How Do Living Things Obtain and Use Their Food?</p>	<ol style="list-style-type: none"> 1. What constitutes a living machine? 2. How are living things equipped for securing food? 3. How do green plants manufacture food? 4. How is food prepared for use by living things? 5. How is the food carried to the points of use in living things? 6. Why is the balanced diet necessary for health? 7. How do living things obtain energy from food? 8. How are wastes removed from the bodies of plants and animals?

Table 10 (continued)

Unit Number and Major Problem	Sub Problems for Unit
IV. How Do Living Things Respond to Their Surroundings?	<ol style="list-style-type: none">1. In what ways is the behavior of plants and animals the result of responses to stimuli?2. What determines the level of behavior of which a living thing is capable?3. What is the nature of the nervous mechanisms of the human body?4. How does man differ in his behavior from other living things?

Source: I. Daniel, Course of Study Fall Semester Biology I, 1938
(Chicago: Board of Education, Bureau of Libraries, Microfiche, 1938.

Another pattern that can be seen in the course content is the problem solving approach. Problems such as interactions, classification, nutrition, behavior, environment, reproduction, growth, adaptation and heredity are stated in the frame of topics. These problematic situations and course content can be seen in the following two tables.

The plan of instruction for the Biology II course, Spring Semester, 1938 can be seen in Table 11.

No textbooks were recommended for these biology courses. For good discussions of the unit method and the steps in scientific reasoning the teacher was referred to: (1) Preston, Carlton E., The High School Science Teacher and His Work; (2) Pieper, Beauchamp and Frank, Teachers Guidebook to Everyday Problems in Biology; (3) Curtis, Francis D., A Teachers Manual For Biology Today; (4) Hunter, George W., Science Teaching; and (5) Morrison, H.C., Practice of Teaching in Secondary Schools. All of these texts mirror Daniel's course of study.

In his annual report (1939-1940) to the Chicago Board of Education, William H. Johnson, the Superintendent of Schools, emphasized that although the sciences had had an important position in secondary education for many years, its role was far more significant and prominent than ever before. Science training must prepare adolescents for meeting their needs in the basic aspects of living. Further, it must support general education in its efforts "to promote the fullest possible of personal potentialities, and the most

Table 11

Table of Contents Biology II

Unit Number and Major Problem	Sub Problems for Unit
V. How Do Living Things Depend Upon Their Physical Surroundings and Upon one Another?	<ol style="list-style-type: none"> 1. What are some relationships between plants and animals that are mutually beneficial to them? 2. What are some relationships between plants and animals that are harmful to them? 3. How is the balance of life maintained? 4. What are some special adaptations that living things have made to their surroundings? 5. What are the evidences that living things and their environment are constantly changing? 6. How may the geographical distribution of living things be explained?
VI. How Do Living Things Reproduce Their Own Kind? (Activities: (1) Demonstrate spores in yeast and amoeba; (2) examine living Hydra for buds; and (3) prepare and study yeast cultures, locate buds.)	<ol style="list-style-type: none"> 1. How do the simplest living things reproduce their kind? 2. How is sexual reproduction accomplished in plants? 3. How is sexual reproduction accomplished in animals? 4. How do living things reproduce vegetatively? 5. How do living things provide for their young?
VII. How Do Living Things Grow?	<ol style="list-style-type: none"> 1. How do cells grow? 2. How do fertilized eggs form plants and animals? 3. How do embryos develop into young plants and animals? 4. How is the growth of living things regulated?

Table 11 (continued)

Unit Number and Major Problem	Sub Problems for Unit
VIII. How Are Living Things Improved?	<ol style="list-style-type: none"> 1. What are the evidences of the operation of laws governing heredity? 2. What are some of the laws governing heredity in living things? 3. What are the causes of variations in living things? 4. How can we make practical use of the laws of heredity with plants and animals? 5. Can society improve the mental and physical qualities of the human race?
IX. What Interesting Features of the Living World Are Revealed in Spring?	<ol style="list-style-type: none"> 1. What are the relations of the the common birds of the Chicago region to human affairs? 2. What are the common spring flowers of the Chicago region? 3. What are the relations of fish to human affairs? 4. What are the biological aspects of the ponds and streams of the Chicago region? 5. What are some critical suggestions for the home and garden? 6. Why is it essential that wild life of the nation be conserved?

Source: I. Daniel, Course of Study Biology II, 1938.

effective participation in a democratic society."³⁰ Science must continue to give adequate training in wide experience and knowledge so that the interests and abilities of the individual would be fully explored.

According to the report, general science became an integrated course of experiences designed to introduce the student to the various fields of scientific knowledge. The course in biology no longer adhered to the strict divisions of botany, zoology and physiology. The course drew from all branches of the "science of life" to stimulate the student's interest and lead toward the greatest development of their potential. Science teaching in Chicago's high schools was organized to reflect the tenets of progressive teaching practice.³¹

For the school year, 1940-1941 the superintendent reported that in the biology course offered, students came in actual contact with living things in the laboratory and activities in the field. They saw them develop, reproduce and respond to the environment. They learned how plants manufactured their food supply, how living things are classified, and the importance of heredity. The Superintendent believed that an interest in, and appreciation of the world of living things would give the student an intelligent understanding of their

³⁰Annual Report, City of Chicago, For the School Year 1939-1940
(Chicago: Board of Education, Bureau of Libraries), p. 169.

³¹Ibid., pp. 169, 171.

surroundings and of their own body.³²

John Edwin Coe, a teacher at Lake View High School in Chicago believed that studying biology should aid the student in the search of the means for a better living and a more fulfilling life. Biology, the science of life, should be able to point out that means for obtaining these ends. It should give the knowledge and the inclination toward activities which bring about happy and successful living.

The basic needs of life according to Coe were food, clothing and shelter, health, marriage, happy home and social life; an interesting occupation; and a satisfactory philosophy of life. Biology interpreted for the students their surroundings, inanimate and animate. Studying biology would help the student understand the need for certain types of food. Health should be considered from both its physical and mental aspects. Biology considered the physical structure and the chemistry of the body. Further, the high divorce rate showed that much unnecessary mental suffering could be avoided by a better knowledge of the biological laws which are at the basis of eugens. Studying biology also helped students appreciate the benefits of government regulation of foods and drugs and of the proper disposal of garbage and sewage. Finally, in the home, biology would teach the student how to care for pets; how to grow plants and keep

³²Annual Report of the Superintendent of Schools, For the School Year 1940-1941 (Chicago: Board of Education, Bureau of Libraries), p. 160.

aquaria, activities which added to the pleasure of their lives.³³

Due to the critical World War II conditions, The Chicago Public Schools in Wartime was published as the Annual Report of the Superintendent of Schools for the school years, 1941-1942 and 1942-43. Superintendent Johnson reported that wartime demands had raised the difficult question of a balanced selection for an instructional program. Certain worthy peacetime goals had diminished in importance while others acquired greater significance.³⁴

In the first two years of high school science the emphasis was directed toward conservation of foods, health, materials and resources. This study included conservation of doctors and nurses as well, since they were needed at the front lines of battle. The units on physiology stressed the importance of parts and functions of the human body with instructions for emergency treatment if needed. A more thorough study was made of diseases, germs, and the best way to prevent and combat old and new diseases. Sophomore students made a study of malaria, the mosquito, the attacks upon the human body, and the most affective emergency treatments. The course of study in biology was given a new emphasis through the biology of war. This was supplemental to the texts' content. All units became a part of a unified plan for victory. Every topic in the course lent itself to vital war applications. The superintendent stated "Even aviation has

³³ John Edwin Coe, "Why Study Biology?" American Biology Teacher 2 (February, 1940): 113-116.

³⁴ The Chicago Public Schools in Wartime (Chicago: Board of Education, Bureau of Libraries, 1941-1943), p. 160.

its entire foundation in the winged creatures of nature in the birds, bees, butterflies and insects. The basic principles of flight are studied in these lessons on birds and their winged allies."³⁵

Johnson also reported that the scarcity of certain vegetables, due to shipping difficulties caused by the war, coupled with the need of increasing amounts of all foods for the armed forces stimulated the planting of victory gardens at many of the schools and homes. A careful study, he continued, of the selection of seeds, preparation of the soil, best methods of planting, fertilizing, cultivating and watering of the plants had been made by the teachers of science to aid the students in their gardens. As a contribution from the Chicago Teachers' College, publications issued by the science faculty on soil conservation and advice pertinent to victory gardens were issued.³⁶

The biology texts in Chicago's secondary schools in the late 1940s and mid 1950s saw no new areas to be developed in the curriculum. The course was basically the same as it had been before and during World War II. The major thrust of the Chicago Public schools during this period was towards excellence in general education for the students.

Biology Textbooks Used in Chicago Secondary Schools, 1929-1939

The biology textbooks adopted for use during this period were of the blended type and were arranged around plant biology, animal

³⁵ Ibid., p. 190.

³⁶ Ibid., pp. 71-72.

biology and human biology. As a miscellaneous topic heredity and evolution in most books were limited to one or two pages. In New General Biology, Smallwood, Reveley and Bailey, Darwin's name was only mentioned. In most of these books, Darwin's scientific background and family were discussed.

The topics that received the most attention in plant biology were plant physiology, forestry and classification. In animal biology, morphology, classification and life processes were stressed. In human biology, the systems (digestive, circulatory, etc.) were the focal points of interest. Health and foods were also discussed (See Table 12).

Basic Biology textbook on the Approved List, 1946-1950

In Chicago Secondary Schools

The content of Modern Biology by Truman J. Moon, Paul B. Mann and James H. Otto (see Table 13) was in ten units. The units were: life and the cell; the classification of living things and their relationships; plant life with particular reference to the flowering plants; lower plants; simple animals; the vertebrate animals; biology of man; health and disease; genetics; and conservation. Like Moon's earlier text the pattern of content is very orderly and the chemical basis of life is discussed. The topics included: structure and function of leaves; food and nutrition; process of digestion; principles of heredity; physical factors of the environment; inheritance in man; evidence of change in evolution; conservation of forests; sense organs and sensations; soil and water conservation; and conservation of wild life. This textbook was revised in 1956. It probably remained on the approved list throughout the 1950s.

Table 12

Textbooks and Laboratory Manuals
Adopted For Use During the Period 1929-1939
in Chicago Secondary Schools

Name of Text/ Laboratory Manual	Publisher	Year Adopted
Van Buskirk, Smith and Nourse, <u>The Science of Everyday life</u>	Houghton Mifflin Co.	1929
Humphrey, <u>Key Experiments in General Science</u>	D.C. Heath and Co.	1929
Smallwood, Reverly, and Bailey, <u>New General Biology</u>	Allyn and Bacon Co.	1929
Lake, Adell and Welton, <u>General Science Workbook</u>	Silver, Burdett and Co.	1929
Smallwood, <u>A Guide for the Study of Plants</u>	D.C. Heath and Co.	1929
Adell, Dunham and Welton, <u>A Biology Workbook</u>	Ginn and Co.	1929
Bailey and Green, <u>Laboratory Manual for General Biology</u>	Allyn and Bacon Co.	1929
Blount, <u>Health-Public and Personal Moon, Laboratory Manual for Biology for Beginners</u>	Allyn and Bacon Co. Henry Holt and Co.	1929 1933
Peabody and Hunt, <u>Biology and Human Welfare</u>	The McMillan Co.	1933
Wheat and Fitzpatrick, <u>Advanced Biology</u>	American Book Co.	1933
Pieper, Beauchamp and Frank, <u>Everyday Problems in Biology</u>	Scott Foresman and Co.	1933
Hunter, <u>Problems in Biology</u>	American Book Co.	1933

Source: Board Proceedings, 7-10-1929-6-25-1930, p. 2047; 7-8-1931-7-12-1932, p. 178; 7-12-1933-7-2-1934, pp. 82, 90; 7-8-1936-6-23-1937, pp. 90, 478; 7-14-1937-7-6-1938, pp. 1604-1607; 7-13-1938-6-30-1939.

The Board Proceedings show that these textbooks remained on the authorized list until at least 1939.

Table 13

Textbooks on Approved List for Use in Biology
Botany and Zoology During the Period 1946-1950

Name of Text	Publisher	Date Approved
Basic		
Smith, <u>Exploring Biology</u>	Harcourt Brace Co.	1949
Moon, Mann and Otto, <u>Modern Biology</u>	Henry Holt and Co.	1947
Vance and Miller, <u>Biology For You</u>	J.B. Lipincott Co.	1946
Sanders, <u>Practical Biology</u>	D. Van Nostrand Co.	1946
Auxillary		
Curtis, Caldwell and Sherman, <u>Everyday Biology</u>	Ginn and Co.	1946
Kroeber and Wolff, <u>Adventures with Animal and Plants</u>	D.C. Heath and Co.	1948
Fenton and Kambly, <u>Basic Biology</u>	The Macmillan Co.	1947
Baker and Mills, <u>Dynamic Biology Today</u>		1948
Hunter, <u>Biology in Our Lives</u>	American Book Co.	1949
Curtis and Sherman, <u>Biology in Daily Life</u>	Ginn and Co.	1949

Source: Board Proceedings, 7-14-1948-6-22-1949; 7-13-1949-6-28-1950.

CHAPTER IV

DEVELOPMENTAL TRENDS: 1957-1980

Social and Educational Trends

With the advent of the first Russian Sputnik in 1957, the schools were blamed for most of our national problems. General publications, television, radio, and other mass media accused the schools of incompetence and malpractice. Most critics blamed the "failure" of American education on the "new" practices and advocated a return to traditional "hard" or "basic" subjects. University professors and other professionals such as Arthur Bestor and Admiral Hyman Rickover, called for the drastic overhaul of American public education. When Admiral Rickover testified before Congress in 1962, he attacked the Education for All American Youth Study. He felt strongly that the comprehensive high school with the common learning approach for all students was grossly unwise.¹ Much of the criticism centered on the high school. Some blamed the tie up between state departments of education and schools for the poor quality of education in American schools.

The Congress of the United States also became involved. Declaring that the "security of the Nation" was at stake in the "present emergency", Congress called for emphasis on science and

¹Hyman G. Rickover, American Education - A National Failure (New York: E.P. Dutton and Co., Inc., 1963), pp. 161-162.

technology in our educational programs.² In passing the National Defense Education Act (NDEA) in 1958, Congress authorized loans to students preparing to be teachers, and for those who showed superior ability in science. Money was appropriated for educational programs in the sciences. The response to Sputnik practically revamped the high school science and biology curricula.

James B. Conant, former President of Harvard University, was funded by the Carnegie Corporation through the Educational Testing Service, to study the American high school. Conant's report, published in a book titled The American High School Today (1958) called for maintaining the comprehensive high school, but with some changes. He suggested including subject-by-subject groups according to ability and establishing a minimum elective program for the academically talented. Conant was an influential factor in the continued existence of the comprehensive high school.³

One of the most important developments in education in the 1960s was the Elementary and Secondary Education Act (ESEA). Put into law in 1965 to fight the War on Poverty, the bill eventually provided billions of dollars for general school purposes. Of special import, was Title I, which originally allotted over one billion dollars to school districts on the basis of the number of school children they had from families of under \$2,000 annual income. Education was looked

²Edward A. Krug, Salient Dates in American Education, 1635-1954 (New York: Harper and Row, 1966), p. 140.

³James B. Conant, The American High School Today (New York: McGraw Hill Book Co., 1959), pp. 44-76.

on at this time as an important instrument in removing the damaging effects of poverty from the country.

In the late 1960s the public school curriculum was again under fire--this time for lack of "revelance". The educational reforms of the late 1950s and early 1960s had removed the science program from human problems and concerns. A reaction was not long in coming. Throughout the decade of the 1960s enrollments in the sciences plummeted. Many young people were turning to the social sciences and humanities, searching for educational experiences that would bring them into touch with the "real world".

There was no doubt according to some writers on the subject that the demand for revelance in the curriculum was a result of the social forces of that time. The society itself was rife with protest. A closer look showed that there were symptoms of what some called a "sick society". Almost overnight people who had been overlooked by society shot into visibility. Poverty, racial discrimination, and the spoiling of our environment emerged as a popular issue. Idealistic youth demanded a curriculum which they could use to combat social problems and make a better world.

The nation, and the schools, adopted a more conservative stance in the 1970s. The free or new school movement which had grown rapidly in the late 1960s peaked in the early 1970s. "Back to basics" became a popular slogan. Some states enacted minimum competency legislation and became more fiscally conservative. However, the federal government increased its activities in the educational sphere, becoming involved in such areas as special education, multicultural

education, desegregation and women's rights.

Debates over the control of schooling, the rights of parents, church and state resurfaced in the late seventies. These rights were reminiscent of the nineteenth century and were as intense at this time as they were then. And more recently, in 1983 the publication of A Nation at Risk signaled the beginning of debate on educational reform. There was a sense of urgency in the report. The report claimed that the educational foundations of our society were "being eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people."⁴ The reaction by the public was swift. Many indicted the quality of education. Some including Boyer, believed that science education was deficient in the schools. There have been a number of curricular reform movements in response to the National Commission report and the debate is on going.

General Biological Trends

The Biological Science Curriculum Study (BSCS) began in 1958 with a mandate to improve biological education at all levels. It was organized under the sponsorship of the American Institute of Biological Sciences (AIBS) with financial support from the National Science Foundation (NSF). The directions for the BSCS was provided by a twenty-seven member steering committee, which included research biologists, high school biology teachers, science supervisors, education specialists, medical and agriculture educators and university administrators.

⁴Ernest L. Boyer, "Reflections on the Great Debate," Phi Delta Kappan 65 (April, 1984): 525.

Mayer noted that the BSCS committee was aware of the fact that most of the problems in biology education had already been identified. Over the past seventy years curriculum studies had discussed issues and made recommendations for solutions. Mayer believed that if curriculum studies, such a BSCS, were to make an impact on the way biology was taught, a new plan would have to be created and implemented.

In discussing the educational levels on which to focus Mayer indicated that perhaps the greatest impact could be made at the secondary school level. At this level, in the United States, some 2,500,000 students annually took biology. For many, it was their first and last contact with science. Therefore, at this point, the greatest number of citizens would be contacted and acquainted with the science of biology which seemed to have the greatest immediate application and impact on the general population. When problems such as health, personal hygiene, sanitation, population, and nutrition were considered, it was clear that biology touched almost every facet of life. Once this had been determined, according to Mayer, it was a matter of how to make the greatest possible impact in the shortest amount of time.⁵

Trying to determine what materials should be provided, the BSCS steering committee examined the textbooks which were currently in use. They found them to be attractive, but dull. In many cases, they were

⁵William V. Mayer, "Biology for the 21st Century," The American Biology Teacher 28 (May, 1967): 357. Mr. Mayer was President of the National Association of Biology Teachers in 1967.

behind the times and devoid of intellectual content. For example Mayer pointed out that one book never mentioned the word "evolution" in either the index or body of the text, in spite of the fact that it had been the major unifying principle whereby all biology was made understandable. Textbooks seemed to require rote memorization and recitation of dull, dry facts. They were strongly vocabulary-oriented. The major emphasis in these textbooks was on taxonomy and morphology and the scientific enterprise was either ignored completely or placed in a chapter labelled "scientific method" and then never referred to again. From an examination of textbooks in use, the time seemed right for the creation of new texts which focused on new thought. The best thoughts of the twentieth century would be picked and applied to the life of the average student.

With this in mind, BSCS writing conferences were held during the summers of 1960, 1961, and 1962. The conference writers' purpose was to prepare high school biology courses suitable for use in the average high school. The courses would give students a basic understanding of science and build scientific literacy to prepare the student for later responsible citizenship. The writing team was represented by biologists with varying interests. They concluded that a student could obtain a concept of modern biology from different approaches while still retaining the core and dimensions of biology. Some biologists thought molecular biology was the fundamental area of biology on which all biological knowledge was based. From this belief

the Blue Version,* or the molecular approach was conceived. Other biologists believed that the cell was the most fundamental, structural and functional unit of all living organisms. The Yellow Version* or cellular approach was conceived from this idea. A third group of biologists believed that an ecological approach was the best way to present biology to high school students. The Green Version,* or ecological approach, was the outgrowth of this team. The three versions have slightly varying approaches, but the basic content of all the texts are similar. The BSCS claimed the level of difficulty of the three versions was the same but this writer believes that the Blue Version, the molecular approach, is the most difficult. To understand this text the student must have a basic understanding of chemistry. BSCS reports have also claimed that no one version is more appropriate for urban, suburban, or rural students. However, more analysis and continuing study must be done to substantiate this claim.

A series of themes or conceptual schemes were selected to bind together the various parts of the BSCS program and the three text versions. The unifying themes were: (1) change of living things through time-evolution; (2) diversity of type and unit of pattern of living things; (3) genetic continuity of life; (4) the relationship of organisms and environment; (5) the biological basis of behavior; (6) complementarity of structure and function; (7) regulation and homeostatis, the maintenance of life in the face of change; (8) the history of biological concepts; and (9) pervading all versions,

*See appendix for organization, content and sequence of topics.

sciences as inquiry: the nature of science and scientific investigation. These unifying themes represented the major goals of BSCS and identified the direction of teaching.⁶

According to the BSCS Committee the biology curriculum should provide students with an understanding of: man's (sic) place in the scheme of nature; the structure and function of the body; and what was presently known regarding problems of evolution, human development and inheritance. Other goals focused on the diversity and interrelations of all living creatures; the biological basis of problems and procedures in medicine, public health, agriculture and conservation; the historical developments in biology and its relationship to contemporary problems, technology and the nature of society. Further, the committee envisioned that the high school student would develop the ability to conduct scientific inquiry.⁷

A discussion by three authors on the BSCS program; Mayer (1967), Tanner and Tanner (1974) and Shymansky (1984) is presented to highlight differing opinions regarding the content and focus of the reform measure.

According to Mayer, because change is always traumatic and is strongly resisted, universal acceptance had not been expected when the BSCS produced its first materials. Surprisingly, however, the program was met with very little criticism. Part of the acceptance was to be

⁶Paul De Hart Hurd, New Directions in Teaching Secondary School Science (Chicago: Rand McNally and Co., 1969), p. 153.

⁷Ibid., p. 155.

found in the materials that were made available to the teachers. The teacher was the crucial part in any curriculum study. Regardless of the textbooks that were written and the good intentions that were developed around a program, unless the teacher understood what was to be done and was sympathetic with it, the program would fall short of its original expectations and, in many cases, fail completely.⁸

Looking ahead to *Biology for the Twenty-first Century*, Mayer suggested that we are on a straight line and the BSCS was only a way station on that line. Some will imitate it and others will pass it by. Scientists and educators were certain that the lag time between scientific discoveries and their presentation in the schools would be drastically cut. Further, it was likely that we would have the situation which prevailed in the earlier part of this century where subject matter emphasis was as much as sixty years or more behind the times. A partial solution to the time lag was the involvement of university research scientists in a cooperative effort with educators for the production of new materials. The team approach to the preparation of scientific classroom materials by curriculum studies will become more evident. Mayer also suggested as laboratory work becomes more accepted and acceptable, it will be used not simply to illustrate something in a textbook, but to illustrate something in place of a textbook.⁹

⁸William V. Mayer, "Biology for the 21st Century," The American Biology Teacher 28 (May, 1967): 358-359.

⁹Ibid., pp. 359-360.

Mayer felt, that in the future when looking back and thinking of the BSCS it will be thought of as rather primitive to present biology as an experimentally oriented, inquiring, scientific process. We will be looking back from a much firmer base and with the knowledge that, in the evolution of science teaching and textbooks, BSCS had an important part to play.¹⁰

The three course versions of high school biology developed by the BSCS were designed to represent a structure of interlocking ideas, concepts, and approaches. The course versions were intended to present biology as viewed by the biologist. Consequently, Tanner and Tanner pointed out that the subject matter bore little relationship to adolescent problems, needs and interests and to the relationship of biology to societal problems. Yet the BSCS staff maintained that the courses were intended to serve a general education function. This claim was contradicted by the focus of the course content on the sophisticated physical and chemical bases of biological phenomena, to the neglect of personal-social problems, and by the subsequent finding that the subject matter was too difficult for forty percent of the students who normally take biology in the tenth grade.¹¹

Other claims, namely, that the BSCS course resulted in superior pupil achievement and more favorable pupil attitudes when compared with the so-called traditional (conventional) biology course were not substantiated by experimental research.

¹⁰Ibid., p. 361.

¹¹Daniel Tanner and Laurel Tanner, Curriculum Development: Theory into Practice (New York: Macmillan Publishers, 1972), p. 443.

Further, in the face of exploding societal problems during the late 1960s an increasing number of scientists and educators began to level criticisms of the major curriculum projects in the sciences. Some believed that science education was too important to be left in the hands of scientists who hold a narrow view of science and were not concerned with its social implications.¹²

In recent years, the BSCS staff has begun to develop materials that relate biology to adolescent and social problems. Reports by the BSCS staff indicate that the new BSCS programs will seek to bridge the many interfaces of science and society.

Shymansky's quantitative synthesis research, also called meta analysis* focused on twenty-five years of research on comparing student performance in the new science programs to that in more traditional programs. Shymansky defined new programs as those which were developed after 1955; emphasized the nature, structure and processes of science; integrated laboratory activities into course discussions; emphasized higher cognitive skills and understanding the nature of science. Traditional programs, according to Shymansky were those which were developed prior to 1955; emphasized knowledge of scientific facts, laws, theories and applications; used laboratory activities as verification exercises at secondary applications of concepts previously covered in classes. Three hundred and two studies

¹²Ibid., pp. 443-444.

*Meta analysis is a term used by G.V. Glass (1976-1978) to describe the process of analyzing the results of a collection of studies on one topic.

were examined to compare the performance of two groups (new vs traditional). They reviewed four criteria: student achievement, attitudes, process skills and analytic skills. Using the meta analysis, Shymansky calculated a common statistic for measuring each performance criterion. He also looked at the correlation between sex, I.Q., ability grouping, socioeconomic status and teacher background and experience. His findings were as follows: (1) BSCS biology was the most successful of the new high school science curricula; (2) Students responded more favorably to all versions of the BSCS program than they did to traditional biology courses; (3) Predominantly male classes responded less favorably to BSCS than did mixed classes; (4) High-IQ, high ability students showed the greatest gains in response to BSCS biology; (5) Teachers with greater experience and educational background were more successful with BSCS programs; (6) Students from very large suburban and urban schools responded most favorably to BSCS biology; and (7) A general science background made no difference to performance in BSCS biology.¹³

Shymansky believed that the BSCS programs were far more successful than educators were willing to give credit for. In light of his findings, he suggested that the discarding of the BSCS curriculum would contribute to the current crisis in education.

In 1957 the Soviets launched a satellite into space, an event that affected science education in America dramatically. Sputnik was

¹³James Shymansky, "BSCS Programs: Just How Effective Were They?" The American Biology Teacher 46 (January, 1984): 54-57.

received as an indication of Soviet scientific-technological superiority. The public demanded improved science education to restore national pride. "Inferior" science education was acknowledged and funds for improving the situation were appropriated. With federal aid, the NSF, the Office of Education and the National Institute of Education, through such efforts as the NDEA title programs, provided significant support for science education. In the case of biology education, major funding occurred after the BSCS in 1959 by the American Institute of Biological Sciences.

The 1960s and 1980s ushered in new problems. Social unrest, political problems, environmental concerns and a loss of faith in science education created a climate of protest and questioning of the biology curriculum which continues.

Biological Trends and Textbooks in Chicago Secondary Schools

Recognizing the revolution in biological knowledge, Benjamin Willis, the Chicago General Superintendent of Schools, reported in 1967 that the scientific progress in the past thirty years had been so rapid that educators had attempted to group scientific-technological advances under blanket phrases such as Atomic Age and Space Age. The impact of these breakthroughs had not only affected the entire socioeconomic life of America, but had also strengthened our position in world leadership. Willis believed it was incumbent upon the scientific community and teachers of science, to maintain a constant dialogue concerning new discoveries and techniques so that those findings could be reflected in the curriculum. Consequently, the subject matter and methods of teaching had to be continually evaluated

by: (1) able scientists who would decide what should be taught; (2) teachers regarding what should be studied; and (3) secondary students.

With this intent, material in the Curriculum Guide for Science: Biology for the Secondary Schools was revised and many of the newer approaches were included. This curriculum was a series of textbooks recommended for use in the Chicago secondary schools (See Table 14). Concepts and activities in the curriculum guide were designed to increase student participation and to serve as a foundation for comprehensive knowledge and continuing interest in science.¹⁴

The curriculum guide presented a structure upon which a teacher could establish an effective science program for the students. Within this framework sufficient flexibility was provided to give assistance in meeting the major levels of student interest and ability. The BSCS textbooks were also a part of the lists of texts adopted for use by the Chicago Board of Education.

According to the guide the units to be covered were: (1) Basic Needs of Living Things; (2) Basic Needs and Characteristics of Cells; (3) Function, Structure, and Classification of Living Things; (4) Continuity of Life; (5) Ecological Relationships of Living Things; and (6) Human Ecology.¹⁵

Addressing the approach to teaching secondary school science, of which biology was a part, Willis defined the discipline as an orderly

¹⁴Biology for the Secondary Schools (Chicago: Board of Education, Bureau of Libraries, August 19, 1968), pp. i-ii.

¹⁵Ibid.

and interrelated arrangement of knowledge based upon critical observation and experimentation. The importance of science, according to Willis demanded that efficient methods for transmitting the achievement of science to students, along with some understanding of how these achievements should be obtained. Further, Willis suggested that research in the field of education indicated that children learned best by using methods of discovery, problem-solving, and inquiry, followed by evaluation.¹⁶

Science education in the Chicago public schools was focused upon the individual. The program was designed to stimulate the students' intellectual curiosity in order to help them understand their environment and challenge them to explore the unknown. Skills of problem solving were developed through experiences and application of the process of science. The general objectives of the biology course were: to develop an understanding of basic biological concepts; to give the student opportunity for supervised laboratory work; to advance the quality of the students' scientific thinking; and to develop the ability to use qualitative and quantitative methods of investigation.¹⁷

Finally, Willis concluded that rapid development of scientific and technological advances had influenced our culture to such an extent that improving the science program was a constantly changing process. Committees of teachers and administrators, with university

¹⁶Ibid., p. 282.

¹⁷Ibid., p. iii.

scholars serving as consultants reviewed the program at all levels in four year cycles. The Curriculum Committee on Science (1963-1965) was responsible for the revised Curriculum Guide for Science. The committee was formed in 1963 and served until 1965 as part of a continuous program of curriculum development and evaluation.

Subsequent board reports during the 1970s and 1980s showed no evidence of discussion on the subject of biology teaching. Board documents detailing the report of the superintendent under the Administration of Redmond, Hannon, Caruso and Love focused on concerns other than the teaching of biology.

A careful look at the textbook lists, however, showed that there were no significant changes in the textbooks adopted for use. New editions of previously approved texts were used rather than replacements.

As can be seen in Tables 14, 15, and 16 the biology textbooks on the approved list are grouped according to ability level. The multi-track scheme of grouping was created in Chicago's high schools to meet the problem of wide diversity of achievement among students. There were four tracks or ability levels. The lowest, or Basic track, was for pupils whose reading achievement was below sixth-grade level. The Essential track was for those with achievement between sixth- and the beginning eighth-grade level. The Regular track was for those with achievement at their grade level or just below. The Honors track was for students who were a year or more above their grade level. Above the Honors track was an Advanced Placement level of senior courses which are taught at the college level and were accepted for

Textbooks Adopted by the Board of Education During the Period
1957-1984 with Specific Reference to Biology, Tables 14-16

Table 14

Textbooks on Approved List on the Supplement to the Teaching
Guide for Science, 1961 Grouped According to Ability Level

Textbook/Workbook/Lab Manual	Publisher
Essential	
Eisman, Louis and Tanzer, Charles <u>Biology and Human Progress</u>	Princeton Hall Inc., 1958
Eisman, Louis and Tanzer, Charles <u>Workbook for Human Progress</u>	Princeton Hall Inc., 1958
Fitzpatrick, Frederick L. and Bain, Thomas D. <u>Living Things</u>	Henry Holt and Co., 1958
Fitzpatrick, Frederick L. and Bain, Thomas D. <u>Living Things Workbook</u>	Henry Holt and Co., 1958
Heiss, Elwood D. and Lope, Richard H. <u>A Basic Science</u>	Van Nostrand and Co., 1958
Heiss, Elwood D. and Lope, Richard H. <u>Activities in Biology</u>	Van Nostrand and Co., 1958
Smith, Ella Thea and Lisonbee, Lorenzo <u>Your Biology</u>	Harcourt Brace and Co., 1958
Regular	
Baker, Arthur D., Mills, Lewis H., & Tanczos, Julius Jr. <u>New Dynamic Biology</u>	Rand McNally and Co., 1959
Mills, Lewis H., and Tanczos, Julius Jr. <u>Students Manual for New Dynamic Biology</u>	Rand McNally and Co., 1959
Dodge, Ruth A., Smallwood, William M., Revely, Ida L. and Bailey, Guy A. <u>Elements of Biology</u>	Allyn and Bacon, Inc., 1959
Gillespie, Darwink <u>Better Biology for High School</u>	Vantage Press, 1957
Gramet, Charles and Mandel, James <u>Biology Serving You</u>	Princeton Hall, Inc., 1958
Kroeber, Elizabeth, Wolff, Walter H. and Weaver, Richard L. <u>Biology</u>	D.C. Heath and Co., 1960
Lauby, Cecilia, Silvan, James C. and Mark, Gordon M.A. <u>Biology</u>	American Book Co.
Sawicki, Nicholas <u>Basic Units in Biology</u>	Republic Book Co., 1957

Table 14 (continued)

Textbook/Workbook/Lab Manual	Publisher
Vance, B.B. and Miller, D.F. <u>Biology for You</u>	J.B. Lippincott Co., 1958
Smith, Ella Thea <u>Exploring Biology</u>	Harcourt Brace and Co., 1959
Wolfson, Albert and Ryan, Arnold W. <u>Biology in a New Dimension: The Earthworm</u>	Row, Peterson and Co., 1955
Wolfson, Albert and Ryan, Arnold W. <u>Biology in a New Dimension: The Frog</u>	Row, Peterson and Co., 1955
Wolfson, Albert and Ryan, Arnold W. <u>Biology in a New Dimension: The Human</u>	Row, Peterson and Co., 1955
Honors	
Brown, Realis B. <u>Biology</u>	D.C. Heath Co., 1956
Coulter, Merle and Dittmer, Howard J. <u>The Story of the Plant Kingdom</u>	University of Chicago Press, 1959
Haupt, Arthur W. <u>An Introduction to Botany</u>	McGraw Hill Book Co., 1956
Moon, Truman J., Mann, Paul B., Otto, James H. <u>Modern Biology</u>	Henry Holt and Co., 1956

Source: Biology for the Secondary Schools (Chicago: Board of Education, Bureau of Libraries, August 19, 1968), p. 225.

The committee responsible for the Supplement to the Teaching Guide for Science was organized in the Fall of 1957 as part of a continuous program of curriculum evaluation.

Table 15

Student Textbook References for Curriculum Guide for Science in
Chicago Secondary Schools Grouped According to Ability Level, 1967

 Author

 Textbook

Essential

 Mason and Peters
 McCracken, et.al.
 Brandwein, et.al.

Life Sciences
Life Sciences
The World of Living Things

Regular

 Otto and Towle
 Weinberg
 Gregory and Goldman
 Smith and Lawrence
 BSCS

Modern Biology
Biology
Biological Science
Exploring Biology
 (Yellow Version) Biological
Science: An Inquiry Into Life
 (Green Version) High School
Biology

BSCS

Honors

 Trump and Eagle
 Baker and Allen
 Kimball
 BSCS

Design for Life
The Study of Biology
Biology
 (Blue Version) Biological
Science: Molecules to Man

 Source: Biology for the Secondary Schools (Chicago: Board of Education, Bureau of Libraries, August 19, 1968), pp. 70, 134, 258.

Table 16

Biology Textbooks on the Approved List 1982-83, and Ability Level

Textbook	Edition	Ability Level
BSCS, <u>Biological Science: A Molecular Approach</u> (Blue Version)	4th	--
BSCS, <u>Biological Science: An Ecological Approach</u> (Green Version)	4th	Regular
BSCS, <u>Biological Science: An Inquiry Into Life</u>	4th	Regular- Honors
BSCS, <u>Biological Science: Interaction of Experiments and Ideas</u>	3rd	Honors
Keeton, William T., <u>Biological Sciences Research</u>	3rd	--
Keeton, William T., <u>Biological Science</u>	3rd	Advanced Placement (AP)
Kaskel, Hummer, Dani, <u>Biology: An Everyday Experience</u>	1st	--
Weinberg, Stanley L., <u>An Inquiry Into: The Nature of Life</u>	--	Regular
Weinberg, Stanley L., <u>An Inquiry Into: The Nature of Life - Laboratory Manual</u>		
Tanzer, Charles, <u>Biology and Human Progress</u>	5th	Essential Regular
Tanzer, Charles, <u>Biology and Human Progress Workbook</u>		
Haskel, Sebastian & D., <u>Biology Investigations</u>	--	Regular- Honors- AP
Hansen, Earl D., <u>Biology Lab Supplement</u>		
Kaskel, Hummer, Dani, <u>Biology: Laboratory Experiences for Biology: An Everyday Experience</u>	1st	--
Wasserman, <u>Biology, Laboratory Manual</u>	1st	
Kimball, John W. <u>Biology, Laboratory Manual</u>	1st	
Oram, Raymond et al., <u>Biology: Living Systems</u>		
Morholt and Brandwein, <u>Biology: Patterns in Living Things, A Laboratory Experience Workbook</u>	1st	--
Morhalt, Evelyn and Morhalt, Paul, <u>Biology: Patterns in Living Things</u>	--	Essential
Small, William, ed., <u>Biology</u>	--	Regular
Smallwood and Alexander, <u>Biology</u>	4th	--
Hanson, Earl D., <u>Biology: The Science of Life</u>		Regular
Kirk, David L., <u>Biology Today</u>	3rd	--

Table 16 (continued)

Textbook	Edition	Ability Level
Rosen, <u>Biology Workshop, Book 1</u> (<u>Understanding Living Things</u>)	1st	--
Rosen, <u>Biology Workshop, Book 2</u> (<u>Understanding The Human Body</u>)	1st	--
Rosen, <u>Biology Workshop, Book 3</u> (<u>Understanding Reproduction</u>)	1st	--
Wasserman, <u>Biology</u>	2nd	AP
Kimball, John W., <u>Biology</u>	4th	AP

Source: The Approved List of Instruction Materials, 1982-1983:
Chicago Public Schools (Chicago: Board of Education),
 pp. 83-84.

credit at some colleges if the student passed an examination in the course set by the College Entrance Examination Board.¹⁸

This writer learned from a telephone interview (March, 1985) with a member of the Bureau of Curriculum, science division, that a stanine score* was used to evaluate students' reading ability on a standardized English examination in the Chicago Public Secondary Schools. A score of 1, 2 or 3 was considered essential achievement; 4, 5 and 6 was average; and 7, 8 and 9 was above average. Acting on the recommendation of biology teachers who objected to a "watered down" biology course, students at the essential level are enrolled in Life science to meet the requirements for graduation. For the biology course offered to the average and above average student the most widely used textbook is Holt's Modern Biology. According to the Bureau, some version of this text has been used in the high schools for fifty years.¹⁹ The forerunner of this text was, Moon, Biology for Beginners adopted by the Board in 1932. Modern Biology, an early version by Moon, Mann and Otto was approved in 1946. The content of a 1965 version can be seen in the appendix. Modern Biology can be regarded as comparable to the blue version of the BSCS texts.

¹⁸ Robert J. Havighurst, The Public Schools of Chicago: A Survey for the Board of Education of the City of Chicago (Chicago: The Board of Education of the City of Chicago, 1964), pp. 204-205.

*A stanine score is any of the steps in a 9-point scale of normalized scores having a mean of 5 and a standard deviation of 2 with integral values ranging from 1 to 9.

¹⁹ Interview with Mary Nalbandian. Bureau of Curriculum, Chicago Board of Education, 11 March 1985.

The Biology curriculum in Chicago's secondary schools can be characterized by the textbooks used. The biology textbook not only determined the content of the course, but the order, examples, and applications of the content. See the appendix for an analysis of selected topics in biology textbooks adopted by the Chicago Board of Education.

CHAPTER V

SUMMARY AND CONCLUSIONS

Historically, biology textbooks in American Secondary Schools have been the key medium through which teachers have organized the subject matter. The text determined both contents and teaching strategies for biology programs. In more recent times biology courses and texts have undergone a complex evolution subject to educational trends, biology knowledge and social issues. Many different purposes for instruction in these sciences have been proposed at different periods, resulting in varying types of curriculum and instruction. These practices and programs have tended to persist to some extent into succeeding periods, resulting in a mixture of old and new in modern programs.

The impetus for science teaching in the secondary schools came with the beginning of the Philadelphia Academy, founded by Benjamin Franklin in 1751. Franklin believed that students should do those things which were likely to be most useful. Descriptive, utilitarian and religious aims formed the basis for this instruction, which included natural history. The beginnings of biology are to be found in knowledge of natural things which have been passed on to succeeding generations. However, books were few, and instruction emphasized the memorization of factual material. Franklin also advocated trips to farms and practice in gardening as part of the science program.

In 1842, a text by Asa Gray influenced changes in botany and zoology. There was a movement away from the natural history approach of studying living things to an emphasis on morphology and internal anatomy. After the appearance of Charles Darwin's theory of evolution in 1860, the study of types that were representative of a given group of the animal or plant kingdom became important. Nineteenth century scientist Gregor Mendel, originator of the science of genetics was also influential.

Biology textbooks have gone through an evolution. This writer's research confirmed Schwab's three developmental stages. In the first stage from about 1890 to 1929, the basic model for the textbook was laid down. The model was determined by what was known about biology at the time and the supposed goals of the secondary school student. In the second stage, from about 1929 to 1957, the earlier textbooks were expanded but not fundamentally modified. In the third stage, of which the Biological Science Curriculum Study (BSCS) was a part, the basic model was reordered and the second stage was restructured.

1890-1929

Educational and biological trends in Chicago's public secondary schools have been influenced by the social issues of the time. In the early 1890s, the nation underwent substantial social change. Large corporations were formed; factories mushroomed in cities like Chicago and millions of immigrants entered America. The nation looked to its schools to make "Americans" out of the urban and rural poor. There was considerable debate about both the purposes and nature of education. As the population increased, more young people were

enrolling in the high schools. Educators with a traditional view saw the high school as preparation for college. Others saw the high school as a means for entering the work force. The educational ideas of Jane Addams supported the theories of John Dewey in that both believed learning to be a continuous process of education as life.

Concern and controversy over the purpose of the high school led to the establishment of various committees to study and make recommendations about the high school curriculum. Prominent among these was the Committee of Ten (1893). This report had a significant impact on the organization of science courses in the secondary schools in that it also included the recommendations of subcommittees in natural history, botany, zoology and physiology. These reports popularized the laboratory method as a means of making science teaching vital and effective. A distinguishing characteristic of this period was a shift from the natural history approach in biological education to courses in botany and zoology.

High school biology courses evolved between 1900 and 1920. Although Whitney dated this beginning for Chicago with the introduction of the laboratory method, the course was not organized around an integrated biological theme. The textbooks published during this period were compartmentalized into botany, zoology, and physiology but were within one cover.

Gradually, biology as related to the environment of the citizenry entered the textbooks. Developments in medicine, hygiene, sanitation, genetics and conservation all had an impact on the kinds of biology taught. Concurrent with this movement in applied biology was the

changing high school population. Child labor laws, compulsory education and the need for vocational training attracted many different kinds of students to the high schools.

A report that had considerable impact on curriculum development from 1900 to 1920 was that of the Commission on the Reorganization of Secondary Education (CRSE) in 1918. The report showed the changes which had occurred in American society. The subjects in the high schools were supposed to foster seven "Cardinal Principles" (aims) which were health, command of fundamental processes, worthy home membership, vocation, citizenship, worthy use of leisure time, and ethical character. The report, like the Committee of Ten reports, was a movement toward the study of biology in its relation to human welfare: health, economic importance, sanitation, vocational aspects and appreciations.

A Health and General Science course offered in the Chicago Public Secondary Schools in 1923 included the influence of the CRSE report. Emphasis was placed on civic problems, health, home applications, industrial applications and essential materials for life.

In 1929 the Chicago Board of Education adopted supplements for teaching botany and zoology provided by the Bureau of Curriculum. The aim of these courses was to develop a scientific habit of thought. Special emphasis was placed on the relations of science to life and its common applications to the students' physical and social welfare.

As science education moved into the twentieth century, it became clear that biology in the high school must justify its contribution to the overall education of students. The Cardinal Principles of

Education provided the framework toward which all science teaching was to make contributions. The movement to "humanize" the study of biology was a generally accepted point of view for curriculum makers. This was evident in course offerings such as civic biology and those including industrial medicine components.

Gradually the textbooks on the approved list of the Chicago Board of Education during the period 1890 to 1929 appeared under the title of biology. These texts supplemented those in botany, zoology and physiology. Later textbooks reflected the growing emphasis upon applied aspects of the biological sciences.

1929-1957

The Depression had a serious effect on education and all other facets of American life. Thousands of families were homeless and millions of people were unemployed. Students went to school and learned about the values of the "American" way of life, and then went home to unemployment, poverty and despair. Throughout these years the emphasis in education and biology continued to be focused on the personal, social and economic needs of the students. Health and consumer education gained prominence in biology textbooks. An intensive study of the science curriculum was reported by the National Society for the Study of Education in 1932. The publication "A Program for Teaching Science", suggested a list of biological principles common to the life needs of an average person.

A report which reinforced the philosophy of this period was that of a committee established by the Progressive Education Association called the Committee on the Function of Science in General Education.

The report claimed that youth needed instruction in personal living, social relationships, and economic welfare.

Throughout the 1930s and 1940s, there was an expressed concern over the focus of biology teaching. The committees reporting in this decade took note of the past developments in science teaching, examined current practices and sought to develop a consistent theory of education in science. These groups were influenced by the American social scene and by the growing importance of science.

World War II and the birth of the "atomic" age raised questions about the purposes of science teaching. The movements which began in the thirties were overshadowed by course adjustments made to meet "wartime" emergencies. Like other courses during the war years (1940s and early 1950s), biology began to focus on applications of basic science - often in areas such as hygiene, disease, conservation of foods, nutrition, and human systems. This emphasis tended to increase the gap between the biology known by researchers and the biology students were experiencing in the classroom. This dichotomy was often identified as a problem by professional biologists. The high school biology course was focused upon the taxonomy of plants and animals; in addition, major attention was centered on cells, tissues, and organ systems.

By 1936 the general biological and educational trends for every freshman in the Chicago public high schools included general science. The major student objective was to learn the scientific method. Keeping pace with the new trends, two courses of study in biology were added to the curriculum in 1938. No textbooks were recommended for

these courses but the teachers were referred to teachers' guidebooks and manuals for reference.

In his annual report (1939-1940) to the Chicago Board of Education, Superintendent William H. Johnson emphasized the importance of the science program in preparing adolescents for their needs in society. The biology course was no longer divided into botany, zoology, and physiology. It drew from all of the "science of life" and was designed to stimulate the student's interest. Live specimens were introduced into the laboratory program to foster that interest.

Like the best of the nation, during World War II certain peacetime goals in the public schools diminished while others gained in importance. The science program was directed toward the war effort. Every topic in the course lent itself to vital war applications. To scarcity of certain vegetables for the armed forces stimulated the planting of victory gardens at many of the schools and homes. The science faculty aided the students and citizens in this unified plan.

The late 1940s and mid 1950s saw no new developments in the biology curriculum at the secondary level. The textbooks adopted for the period were of the blended type, arranged around plant, animal, and human biology. The content of the texts on the approved list for the period 1946 to 1950 were centered on taxonomy, cell biology, human functions, conservation, eugenics and heredity.

The atomic era and the subsequent swift rise of science and technology after World War II helped lead to the origin of the National Science Foundation (NSF) in 1950. Several years later the

NSF assumed major support for high school science curriculum innovation as a part of its overall mission.

1957-1983

Concern for technical manpower needs were accelerated tremendously by Russia's orbiting the first satellite in 1957. The resulting furor of activity related to scientific and technical instruction in our schools was frantic and reactionary. The launching of Sputnik was received as an indication of Soviet scientific-technological superiority. Popular criticism of schools abounded. The public demanded improved science education. The schools were held accountable for our loss of world leadership. University professors and professionals from other fields, called for the drastic overhaul of American public education. Much of the criticism was centered on the high school. Even the Congress of the United States became involved and called for emphasis on the sciences in our educational programs. The federal government, State departments of education, and local school boards provided support for new science education programs.

In the case of biology education, major funding occurred after the formation of the Biological Sciences Curriculum Study (BSCS) in 1950 by the American Institute of Biological Sciences. The first BSCS educational materials were prepared during the summer of 1960 and field tested in the secondary schools during the 1960-1961 academic year.

The BSCS staff, activities, and materials were well received. The public was supportive; the scientific community directed the

improvement efforts, and publication of NSF materials became a standard sequence of events. At its zenith it was estimated that BSCS materials were used in over one-half of the biology classrooms in the United States.

In the late 1960s the schools were attacked for the lack of relevance in the curriculum. The critics charged that the science program had been removed from human concerns. The content of high school biology was essentially what was produced by curricular reforms of the early 1960s. It was biology as seen by the biologist. The course was largely devoid of practical application, or the relevancy of biology to society's problems such as disposal of hazardous materials, acid rain and improper nutrition.

The 1970s ushered in a new set of problems. Social unrest, the Vietnam War, environmental concerns and a loss of faith in science and education created a climate of protest and questioning. At the national level there was a challenge to the appropriateness of NSF curriculum projects. In addition, there was public concern about inclusion of such sensitive areas as sex, reproduction, social issues and evolution in the biology curriculum.

In 1983, the publication of *A Nation at Risk* signaled a new debate on curriculum reform. The reaction by the public was swift. The quality of education in the sciences was questioned. The courses, critics charged, did not prepare students to enter the occupations that require technological knowledge; nor did they open the way toward careers in the natural sciences.

The Chicago Secondary Schools have kept abreast with national

concerns and curriculum reforms. In 1967, Benjamin Willis, the General Superintendent reported to the Board of Education that progress in the sciences mandated a constant dialogue concerning scientific advances so that new findings could be updated in the curriculum. The subject matter and teaching techniques were to be continuously evaluated. The Bureau of Curriculum was assigned this duty.

According to Willis, the importance of science teaching, of which biology was a part, demanded efficient teaching methods. He defined the discipline as an interrelated body of knowledge based upon scientific inquiry. The program in the secondary schools was designed to stimulate the students' curiosity about the dynamics of life, and to give them a working knowledge of biology.

Subsequent reports by the succeeding general superintendents of the Chicago Public Schools during the 1970s and 1980s showed no evidence of discussion on the subject of biology teaching. Their reports focused on quality and excellence through new directions in the educational program.

The biology course in Chicago's public secondary schools can be described by the content of the textbooks that are in use. The texts that are on the authorized list are investigated by the science division of the Bureau of Curriculum in four year intervals. This means that often, new concepts and principles in biology teaching are not quickly adopted for use. For example, the BSCS texts were introduced at a time when the Curriculum Guide was not due for revision. Consequently, teachers of biology had to receive permission

from the board to use BSCS textbooks in their courses.

According to the Bureau of Curriculum most of the high schools use Modern Biology for the "regular" biology course. However, some use the BSCS "Yellow" and "Green" versions. Typically, these texts emphasize new words or concepts. Such words are frequently italicized or set apart. They are often included in the questions at the end of the chapter, and are the focus for quizzes and examinations.

Biology education today bears the imprint of the past. Objectives, organization and practices variously show the influence of past viewpoints, policies and theories. As our knowledge of biology and pedagogy has grown, educational practices have changed. But change has been slow in some instances, and in some practices today we find evidences of long-discredited theories.

The textbooks chosen for the teaching of biology have generally shown the influence of educational reports, biological trends and the social attitudes of the times. Although fundamental changes in the framework of American society have long served as an agent for curriculum reform, changes in recent years appear to have been more intensive than during many periods in the past.

The basic function of a textbook in the biology course is not clear. Is it a learning guide or a summary of useful knowledge determined by some criterion? The biology textbook as a learning resource is one of the unexplored areas of educational research. Further research is needed to determine the functions of the textbook in biology teaching. Additional study on present practices and

policies governing textbook selection would be a useful contribution to the study of biology teaching from an evolutionary perspective.

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APPENDIX A

Appendix A

Biology Teaching in War Time

Unit	Emphasis
I. Nutrition	<ol style="list-style-type: none">1. The three principal functions of foods2. Food needs3. Food values4. Meeting food needs5. Demonstration where possible6. Substitution in case of food shortage7. The nutritive value of left-overs8. The after war problems of feeding the hungry
II. Circulation	<ol style="list-style-type: none">1. Shock2. Stoppage of bleeding3. Prevention of infection4. Fainting5. Blood banks
III. Skeletal System	<ol style="list-style-type: none">1. Fractures2. Sprains and dislocations
IV. Respiration	<ol style="list-style-type: none">1. Partial pressure changes and the ways the body adjusts2. Artificial respiration
III. Heredity	<ol style="list-style-type: none">1. The distribution of the primary races of mankind.2. Migration3. National groups4. Assimilation5. Arts and sciences that originated in "foreign" cultures6. Physical traits and the environment7. Development of communication and transportation

Appendix A (continued)

Unit	Emphasis
IV. Behavior (unit confined to the study of trophism, the nervous system endocrine system)	<ol style="list-style-type: none"> 1. Standardized tests and intelligence, environmental factor 2. Distribution in testing 3. Pre-induction guidance
V. Health	<ol style="list-style-type: none"> 1. Military sanitation 2. The control of contagious diseases 3. The organization and operation of a medical unit 4. The potentialities of the airplane as a secondary vector of disease
VI. Evolution	<ol style="list-style-type: none"> 1. Establish the concept of change through the age 2. Trace the development of human society, refer to the Bible 3. Discuss how a democracy is the most stable social organization
VII. Ecology	<ol style="list-style-type: none"> 1. The interdependence of organisms 2. Apply above concept to

Source: "Biology Teaching in War Time - Some Suggestions for Emphasis," The American Biology Teacher 6 (November, 1943): 27-30.

APPENDIX B

Appendix B

BSCS Biology Textbooks

Organization of BSCS Blue Version (1968): Biological Science:
Molecules to Man

Units	Content
1. "Biology the Interaction of Facts and Ideas"	includes materials on science as inquiry, the variety of living things, conflicting views on the means of evolution
2. "Evolution of Life Processes"	a study of the forerunners of life, chemical energy for life, light as energy for life, and life with oxygen
3. "The Evolution of the Cell"	presents master molecules, the biological code, and the cell theory
4. "Multicellular Organisms: New Individuals"	considers the multicellular organism, reproduction and development
5. "Multicellular Organisms: Genetic Continuity"	includes patterns of heredity, genes and chromosomes, and the origin of new species
6. "Multicellular Organisms: Energy Utilization"	a study of the transport, respiratory, digestive and excretory systems
7. "Multicellular Organisms: Unifying Systems"	treats the regulatory, nervous, skeletal and muscular systems as well as the organism and behavior
8. "Higher levels of Organization"	a study of the human species, populations, societies and communities

Source: Paul De Hart Hurd, New Directions in Teaching Science (Chicago: Rand McNally and Co., 1969), p. 157.

The laboratory investigations were included in the textbook. In addition, there are twenty supplementary investigations listed at the end of the textbook.

The BSCS Green Version, second edition 1968, High School Biology was published by Rand McNally and Company. This version is a combination textbook and laboratory manual. Field and laboratory investigations have been placed throughout the textbook as part of the learning resource on a particular topic. The content of the course represents an ecological approach to the study of biology. The content of this textbook can be seen in Appendix C.

Contents of BSCS Green Version (1968) High School Biology

Sections	Contents
1. "The World of Life: The Biosphere"	a study of the web of life, individuals, and populations, communities and ecosystems.
2. "Diversity Among Living Things"	considers animals, plants and protists
3. "Patterns in the Biosphere"	examines patterns of life in the microscopic world, on land, in the water and in the past.
4. "Within the Individual Organism"	explores the cell, bioenergetics, the functional plant and animal, and behavior
5. "Continuity of the Biosphere"	a study of reproduction, heredity, and evolution
6. "Man and the Biosphere"	considers the human animal and man in the web of life

Source: Hurd, New Directions in Teaching Science, p. 158.

Marginal notes throughout the text are there to assist the student in understanding the text. At the end of each Chapter there are lists of guide questions, problems and suggested readings.

Biological Science and Inquiry Into Life, second edition 1968, is the BSCS Yellow Version and it is published by Harcourt, Brace, and World Inc. The content and sequence of topics can be seen in the following table:

Content and Sequence of Topics
Yellow Version - Biological Science and Inquiry Into Life

Topics	Contents
Unit 1. "Unity"	a consideration of what biology is about, life from life, basic structure and functions, living chemistry, the physiology and reproduction of cells, and the hereditary materials
Unit 2. "Diversity"	a study of beginnings - viruses, bacteria, important small organisms, molds, yeasts and mushrooms, the trend toward complexity the land turns green, photosynthesis, stems and roots-- study of complementarity of structure and function, reproduction and development in flowering plants, the world of animals, diversities among animals; digestion, transportation, respiration, excretion, homeostasis, coordination, support, locomotion, reproduction, and development in multicellular animals, and the analysis of behavior
Unit 3. "Continuity"	patterns of heredity, the chromosome theory of heredity, Darwinian evolution, the mechanisms of evolution and the cultural evolution of man

Topics	Contents
Unit 4. "Interaction"	a study of animal balances in nature, ecosystems, and mankind: a population out of balance; and a perspective of time and life: molecules to man

Source: Hurd, New Directions in Teaching Science, pp. 158-159.

Student guide questions and problems are included in each chapter as well as related readings. Laboratory investigations are in a Student Laboratory Guide, a separate publication.

APPENDIX C

Appendix C

Units and Contents of 1965 Edition Modern Biology

Units	Chapters and Content
1. The Nature of Life	1. The science of life 2. The living condition 3. The chemical basis of life 4. The structural basis of life 5. The cell and its environment 6. Cell nutrition 7. Cell metabolism 8. Cell growth and reproduction
2. The Continuity of Life	9. Principles of heredity 10. The genetic material 11. Genes in human populations 12. Applied genetics 13. Organic variation 14. The diversity of life
3. Microbiology	15. The viruses 16. Bacteria and related organisms 17. Infectious disease 18. The protozoans 19. The fungi 20. The algae
4. Multicellular plants	21. Mosses and ferns 22. The seed plants 23. Root structure and function 24. Stem structure and function 25. Leaf structure and function 26. Reproduction in flowering plants
5. Biology of the invertebrates	27. Sponges and coelenterates 28. The worms 29. Mollusks and echinoderms 30. The arturo pods 31. Insects - a representative study 32. Insect diversity

Units	Chapters and Contents
6. Biology of the Vertebrates	33. Introduction to the vertebrates 34. The fishes 35. The amphibians 36. The reptiles 37. The birds 38. The mammals
7. The Biology of Man	39. The history of man 40. The body framework 41. Nutrition 42. Transport and excretion 43. Respiration and energy exchange 44. Body controls 45. Alcohol, narcotics and tobacco 46. Body regulators 47. Reproduction and development
8. Ecological Relationships	48. Introduction to ecology 49. The habitat 50. Periodic changes in the environment 51. Biogeography 52. Soil and water conservation 53. Forest and wildlife conservation

Source: James H. Otto and Albert Towle, Modern Biology (New York: Holt, Rinehart and Winston, Inc., 1965) in Voss and Brown, Biology as Inquiry, pp. 223-226.

APPENDIX D

Appendix D

Percentage of Pages Devoted to Selected Phases of Biology
Textural Material in Textbooks on the Approved Lists for
Chicago Secondary Schools

The investigation of biology textbooks as shown in Appendix D was mostly limited to texts housed at the Midwest Inter-Library Center. Percentage of pages devoted to a textual phase in the total textbook number of pages was used to determine the amount of emphasis given to a particular topic. The total numbers do not include appendices, indices, or glossaries.

This writer chose the phase heredity rather than genetics. In some of the earlier textbooks (1926-1931) the term gene was not used. The term evolution was seldom seen in the texts investigated before the 1960s. The topic was often listed under such headings as the "Changing World of Life" and "Evidence of Change in Living Things". Discussions on Darwin were mostly one page and focused on accomplishments other than his theory of evolution. Also, in the earlier textbooks, the ecological approach to life was interspersed with discussions on the conservation of natural resources and group interactions. The structure and function of the cell was chosen rather than cell reproduction to show the growing importance of the cell as a unit of life. An increasing amount of knowledge has been gained from its ultrastructure. The chemical aspects of life was limited to the number of pages which was devoted to simple chemistry, i.e., the discussions of the elements and inorganic and organic compounds. Molecular genetics was included to give the reader some idea of when this phase was introduced into the course of study. The three textbooks which contain this topic are respectively, on the regular, honors and advanced placement lists.

Author*	Year Published	Total Number of Pages	Cell Structure and Function	Chemical Aspects	Ecology	Evolution	Heredity	Molecular Genetics
Moon	1926	647	0.93	2.93	3.01	0.57	0.57	--
Peabody & H	1926	568	1.23	--	4.92		0.35	
Kinsey	1926	536	1.12	--	1.87	--	4.10	
Atwood	1927	506	0.99	--	5.73	--	4.72	
Wheat & F	1929	527	1.91	2.66		3.60	5.69	
Smallwood, R & B	1929	709	1.13	--	1.55	--	2.12	
Hunter	1931	706	0.14	--	0.57	0.84	2.97	
Moon & N	1938	865	1.09	2.27	4.16	0.61	3.24	
Curtis, C & W	1940	653	0.86	--	0.43	--	3.44	
Moon, M & O	1947	664	1.66	2.41	3.01	2.26	3.16	--
Baker & M	1948	760	2.10	--	0.39	0.26	9.08	--
Vance & F	1950	687	0.58	--	7.13	4.95	5.82	--
Smallwood, R & B	1952	746	0.54	--	0.54	--	1.74	
Fenton & K	1953	703	2.13	--	2.13	1.28	7.96	
Moon, M & O	1956	713	5.39	1.97	1.70	0.84	4.91	
Moon, O & T	1960	712	3.09	1.82	1.68	2.39	4.33	
Kroeber, W & F	1960	591	2.88	--	0.34	1.18	2.70	--
Trump & F	1963	621	3.70	2.90	2.42	2.25	5.80	
Moon, O & T	1963	669	3.43	1.64	1.79	2.39	4.33	--
Smith & L	1966	695	4.46	2.59	2.44	4.75	10.21	
Gregory & G	1968	783	1.40	1.66	3.45	1.92	5.24	
Weinberg & K	1971	615	4.06	3.58	3.41	3.90	4.06	4.55
Keeton	1972	832	4.09	3.36	6.13	5.89	4.48	4.09
Kimball	1978	824	4.60	4.74	4.61	4.13	3.28	5.09

*The textbooks given in the table by the author's name are:

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- Moon, Truman J., and Mann, Paul B. 1938. Biology.
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- Vance, B.B. and Miller, D.F. 1950. Biology for You.
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APPROVAL SHEET

The dissertation submitted by Addie Beatrice Cain has been read and approved by the following committee:

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

24 May 1985
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