History of Science Education in Indiana High Schools

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The high school course of study before 1873 in Indiana was patterned largely after the college curriculum and it was considered preparatory to college work. As late as 1868, Barnabas C. Hobbs, Superintendent of Public Instruction said, "a uniform system of common schools should imply a regular gradation from the primary, through the intermediate or grammar to the high school, and all with a view to a system of professional work that will look to a sufficient preparatory course in all respects for the College or University."

The first minimum course of study for commissioning Indiana High Schools was established in 1870. Previous to that time, admission to the state's colleges and universities was based entirely upon examinations. The eleventh biennial report of the State Superintendent of Public Instruction for the year ending August 31, 1881 said "In order to establish a more intimate relation between the Common School System and the University System of the state, the State Board of Education, in connection with the trustees of Indiana University, more than ten years since, formulated a minimum course of study, the completion of which would admit pupils from the high schools of the state into the freshman class of that University. Since that time, the State Board of Education has commissioned each year all those high schools, in which it was shown that there were classes of pupils who could complete this minimum course within the year."

Thus students who were certified to have completed the minimum course of study by the local Superintendent of Schools were admitted without examination to both Indiana and Purdue Universities.

The prescribed course of study included the following subjects: Reading, Writing, Orthography, Geography, English Grammar, Word Analysis, United States History, Physiology, Arithmetic, Elementary and Higher Algebra, Geometry (first four books), Latin Grammar, Latin Reader, Latin Prose Composition, Caesar (two books), and Virgil (two books).

The only subjects that may be called science in the original curricula of the high school were geography and physiology. The mold of the high school training was primarily in the classics as a preparation for college.

In spite of the persisting traditional education in the classics of the early schools of the state, there were those who recognized the need for science instruction at least two decades before such changes became effective. In an address to the Indiana State Collegiate Association in Indianapolis, July 7-8, 1870, B. C. Hobbs, president said, "Colleges have been changing their educational studies almost yearly, for the last forty years. Since geology, botany, chemistry, mechanics, civil engineering, mining, architecture, navigation and many other sci-

ences have demanded special attention in our colleges something must yield that their claims may be allowed."

"Economy and necessity are compelling the colleges to modify their curriculums. A scientific course is now made, in most of them, the equivalent of the classical, and the regular scientific feels that he has vantage ground by the change."

President Hobbs discussed the difficulty of providing Greek, especially in the secondary schools, and complained about students studying too much Latin and Greek at the woeful neglect of English. It was a valiant plea to replace Latin and Greek with science and more English.

In 1885, a committee of the State Teacher's Association proposed a Uniform Course of Study for High Schools. The four-year course outlined a plan of study that included twenty percent physical science and twenty percent languages. The sciences that could be offered in the eleventh and twelfth year were physics, chemistry, botany, zoology and physical geography.

In 1892 the State Board of Education arranged two suggested courses of study for commissioned high schools. A minimum high school course of three years required two terms of three months each of physical geography and three terms of science. The four year program recommended three terms each of physics and botany, one each of chemistry and physiology, and two terms of physical geography. Pupils were required to take four subjects per term. Each year was divided into three three-month terms so that a year represented thirty-six months of work, i.e., twelve three month periods.

Some substitution of subjects was allowable, depending upon the quality of teachers, so it was probable that at least one of the proposed sciences could be omitted.

Under comments relating to science in the 1892 report of the State Superintendent the following were significant as to the thinking of science education before the turn of the century:

"The value of science comes from direct contact of the pupils with the objects and processes of nature, not from an accumulation of scientific facts. For high schools with three-year programs it is better to take only one of the sciences. In the four-year's course take those sciences that can be taught best under the circumstances.

"In physics, little can be done in less than one year. Two terms of the year should be devoted to textbook work and experiments by the teacher. Then, spend a third term in laboratory work. Quality, rather than the amount done, should be considered in laboratory work." Similar suggestions were made for the study of chemistry.

Comments pertaining to botany advised to "study the plants themselves. Plants are living things whose manner of living should be studied, and there are hosts of low forms (lichens, toadstools, mosses, ferns, etc.) which must be studied to gain knowledge of the botanical kingdom. The analysis of flowers and herbarium collections are relatively unimportant." Much the same approach was recommended for zoology.

Very little change occurred in the pattern of science offered in the high schools until after 1900. The industrial development of the

state and the need for skills in vocational training began to show its effect. The twenty-second biennial report of the State Superintendent of Public Instruction (1903-1904) mentioned that "the high school should be made a finishing school instead of a preparation for college. Only one percent of our pupils complete college courses." The 1906 report re-emphasized the above and suggested that the curriculum should be related to the needs of the community rather than a preparation for college.

A Uniform Course of Study, adopted in 1907 by the State Board of Education, established sixteen units for graduation from high school. One unit of natural science was required. The change in the science requirement from two years to one was most likely an attempt to fit the program to the needs of pupils for community living rather than for college preparation. However, most of the better equipped high schools continued to offer all of the sciences.

Bulletin 11 (1914-1915) of the State Department of Public Instruction in describing the Uniform Course of Study for High School showed a continuation of the pattern for general education. In remarks pertaining to the sciences it was stated that "botany should be presented with reference to certain fundamental principles that can be worked out and comprehended by high school pupils in the laboratory; for no doubt much harm has been done in the past, both to the science and to the pupil, by attempting to make the work correspond more nearly to the elementary course in the college or university."

It was suggested that teachers of botany and zoology should secure through the Congressman of the district publications of the Department of Agriculture on noxious plants, and beneficial birds, mammals and insects, and reports of the State Entomologist.

For physics it was advised that "the course should emphasize the explanation of natural phenomena in a manner which can be appreciated by high school pupils of average ability and the course should not over-emphasize the mathematical aspects of the subject. Do not discourage the class by much problem solving."

For chemistry the aim should be mainly to "secure an understanding of the fundamental principles and the development of powers of observation, deduction and expression." Analytical work was discouraged unless under the direction of an exceptional teacher. Also, it was recommended that unless high schools could afford fairly good equipment, it would be better not to teach chemistry at all. The high school should not expect to burden the teacher with spending half his time devising equipment.

Little change is indicated in the type of science offered before 1920. Continued attention was given to preparation for skills in the vocations and the contributions science could make toward that goal. An example is taken from Bulletin 30 (1917-1918) of the State Office of Public Instruction concerning the teaching of physics. The topics are indicative of our industrial progress before 1920. They included machines, heating and ventilation, gas engines, velocity of sound, steam engines, telegraphy, electrical power plants, and storage batteries.

Teachers were encouraged to visit local industries to gain information on these topics.

Perhaps the best contribution and stimulus to good high school science teaching up to this time was made by the committee that prepared the Science and Mathematics State Course of Study for Secondary Schools in 1923. The committee was composed of Dr. A. C. Kinsey, Indiana University, Herbert S. Vorhees, Fort Wayne, B. B. Horton, Anderson, Charles L. Brosey, Indianapolis, and E. E. Ramsey, Terre Haute.

The committee set forth a list of well-defined objectives for science teaching. Emphasis was given to developing scientific attitude and special skills through direct contact with the materials of science. Elaborate outlines were prepared for each of the high school sciences and units in biology appeared for the first time.

Bulletin 100 E of the State Office of Public Instruction entitled "Tentative Courses of Study in General Science, Biology, Physics and Chemistry" was prepared by the Department of Science of Indiana State Teachers College and was published in 1933. Some of the changing trends in science were indicated as follows: (1) In biology an attempt was made to strike a liberal compromise between the technical point of view of the experimentalist and the friendly approach of the naturalist in this field, (2) In physics an attempt was made to humanize or socialize the subject matter—to create interest, (3) Chemistry showed a trend to train for the simple questions of everyday living rather than preparation for college. An educational philosophy for training the masses was beginning to show a strong influence.

In summarizing the changes that occurred in science education in our secondary schools during the sixty year period from 1873 to 1933, several developments are significant. By 1885 it was becoming apparent that the European system of classical education was not suitable for general high school education, nor was it necessarily the only valid passport for college admission. It was recognized that especially science and English were being sacrificed at the expense of Latin and Greek.

Indiana, as well as most other states, was in the process of agricultural and industrial expansion. Thus, from 1900 to 1933, the two influences that contributed most to the changes in the high school science programs were (1) the rapidly expanding industrial development of the state, and (2) the increasing number of high school students who were not going on to college. The expanding use of power and machines in the home, on the farm, and in industry called for better understanding of the contributions of science.

From 1933 to 1944, science education expressed largely the same type of development. No radical changes occurred, but continued to parallel the growing machine age. With the advent of World War II and its terrific demand for new scientific achievements in competition with the German and Japanese war efforts we entered a new phase of scientific education.

A comparison of the outlines for teaching science in 1944 (Bulletin 151) and 1954 (Bulletin 217) of the State Office of Public Instruction

distinctly show the influence of the recent developments of the atomic age. This is especially true of the changes appearing in the physical sciences. The topics of gas engines, heating and ventilation, steam engines, telegraphy, electrical power plants and storage batteries have been modified considerably and to some extent replaced by radiation, nuclear fission, rockets, jet-propulsion, electronics and new applications of energy fuels.

The problem of providing an adequate science education to the bulk of the population of high school age while at the same time preparing the scientifically talented children for college is a real challenge to the high school science teacher today. The Indianapolis high schools recently established a two year requirement in science for graduation—one year of biological and one year of physical science. Numerous other schools are now offering four years of high school science, primarily to provide increased science opportunities for the gifted student and as a preparation for college. The better schools are accepting the challenge for better science teaching and the situation can be further improved through the combined efforts of our college scientists and high school teachers.