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Transitions in Texas: The Development of Secondary Science Curricula, 1886-1917

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Transitions in Texas: The Development of Secondary Science Curricula, 1886-1917

by

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Transitions in Texas: The Development of Secondary Science Curricula, 1886-1917

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This dissertation reports an exploration of one statewide case in the remarkable expansion of the American public high school in the early twentieth century. Specifically, it focuses on the curricula of early twentieth century secondary school system of the state of Texas. In particular, its development was shepherded, from 1886-1917, by the University of Texas. The vehicle was the university's program of affiliation with its approval of high schools in the state. Affiliation essentially was a system of accreditation of the state's high schools. It contributed the first systematic effort to provide guidance for the academic programs, teachers, and facilities for the state's rapidly developing high schools. A variety of social, political, and economic conditions affected the University's

affiliation system. These conditions external and internal to the state constituted the formative circumstances for the development of secondary curricula in Texas.

Mathematics, history, English, and Latin were the primary affiliated subjects during the late 1800's. Science offerings did not become affiliated subjects in the University of Texas affiliation program until the early 1900's. This study focused on the development and inclusion of science offerings in the curricula of affiliated high schools. It probed the nature and extent of the science course offerings in the growing number of affiliated Texas high schools. Its findings identify among other matters, the science courses that were offered in affiliated Texas high schools, textbooks used, and laboratory facilities.

The involvement of The University of Texas at Austin in establishing high school curricular standards, the reconfiguration of the school day, the redesign of the curricula, the inspection and affiliation process, all provided standards for improvements in school districts that lacked effective state governmental guidance and supervision. This endeavor by the university, assumed by the State Department of Public Education in 1917, clearly influenced the nature of the high schools of the state at the time and for the century to come.

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Chapter One: Introduction

The period between the Civil War and World War I was a time of change in the United States. The Civil War, aided by progress in science and technology accelerated the development of industrialism that included the factory system, mass production, and specialization. Industrialization also brought about increased urbanization, created new problems in health care and sanitation, and provided difficult political problems. Concurrently, advancements in medical science began to reduce the occurrence and effects of some diseases. Infant mortality began to decrease, average life expectancy began to increase, and millions of immigrants continued to stream into the country. A burgeoning modern society began to flower.[1]

America's schools reflected these change in society. The period from 1825-1860 had been the formative period for the common school. Year by year, the idea of free elementary schools gained public acceptance, spread across the nation, and lead to the establishment of thousands of new schools. Increased numbers of children attended public elementary schools for a greater number of years and by 1914, especially in the cities, a majority of children completed eight

[1] Donald Parkerson and Jo Ann Parkerson, Transitions in American Education, (New York, Routledge Falmer, 2001): 15-19.

years of schooling. As the country grew in size and became more complex, so did the demand for additional education for the nation's youth.[2]

Thus began a second formative period. From 1865-1918, public secondary high schools in America expanded. Throughout the eighteenth and most of the nineteenth centuries, secondary education essentially had been college preparatory in nature designed for only a small number of students (mainly boys) and its curriculum was classical; these secondary schools offered studies principally in Latin, Greek, English, and mathematics. The expansion of general knowledge gradually led to a public demand for a more practical "higher" or secondary education. Soon, new subjects, such as modern languages, biology, zoology, botany, chemistry, physics, geography, manual arts, and commercial subjects became regular curriculum elements in secondary schools. With increasing numbers of students and more subjects, the nature of the secondary school changed and this change generated debates about its purpose. For example, should the new high school be an extension of the common school that all children attended? If so, what should its curriculum be? Should it provide mainly or only a college preparatory program? Kandel observed that the new public high schools took their curriculums from the academies and the purposes that governed the high school became twofold: one, preparation for college entrance and two, preparation for practical work for students who were not college bound.[3] Resolutions of this debate appeared to be as numerous as were the new and

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[2] William E. Drake, The American School in Transition. (Englewood Cliffs, NJ. Prentice Hall, 1955): 199-203.

[3] I.L. Kandel, History of Secondary Education. (New York, Houghton & Mifflin, 1930): 450.

struggling high schools. Each school chose its own curriculum. Few academic standards existed. Accrediting agencies did not exist at the beginning of the period.[4]

A few state university faculties during the post Civil War years noted that entering college students suffered from deficient academic preparation. These university faculties concluded that high schools offerings needed some form of standardization. As higher education became accessible to increasingly wider segments of the general American population, even more students would arrive ill prepared for university study. At the time, almost all universities required entrance examinations as prerequisites for students' enrollment. Some state departments of education set curriculum standards as guidelines, but favored high level of academic standards. Consequently, several state universities initiated programs of accreditation by which they "affiliated" with high schools after their courses were certified satisfactorily "standard" by university policies. These universities then admitted graduates of these affiliated high schools for enrollment without examination. In 1886, the University of Texas began its program of affiliation.[5]

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[4] Raymond Callahan, An Introduction to Education in American Society (New York, Alfred A. Knopf, 1961): 132-137.

[5] Bulletin of the University of Texas #106, "High School Bulletin," 1 April 1908: 5- 7.

The University of Texas and the Affiliation Program

When the University of Texas opened in 1883, only eight public high schools existed in the state.[6] The first high school opened in 1879 in the central Texas town of Brenham.[7] Although the university accepted 221 students for its initial class, either by examination or by faculty approval, professors judged most of them as ill prepared for university work. Realizing that the absence of standards for the state's high schools would hinder the growth of the university into a first class university, the university initiated a program of affiliation with high schools during the school year 1885-1886. Thereafter, university enrollment began a steady increase each year. By the school year 1895-1896, the university renewed its effort to further the affiliation of the state's high schools. It formed a faculty Committee on Affiliated Schools to establish criteria for affiliation that included curricular subjects eligible for affiliation, faculty qualifications, quality of school buildings, classrooms, appropriate textbooks and adequate laboratory facilities. This action created the first enforceable academic standards for public high schools in the state of Texas.[8]

The Affiliation Process in Texas

The affiliation process began with a high school administrator's submission of completed affiliation applications to the University's Committee on

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[6] Frederick Eby, The Development of Education in Texas (New York, Macmillan, 1925): 247.

[7] Brenner Banner, Brenham Texas, (August 20, 1875) Center for American History, the University of Texas at Austin.

[8] Bulletin #106, 5-7.

Affiliated Schools. If these applications were complete, the administrator subsequently submitted student specimen papers (e.g., laboratory manuals of experiments completed, student written examinations from Latin, English, mathematics and history courses, and writing journals) for review and grading by University faculty (departments specifically related to the papers under review). If the faculty judged that the student papers met affiliation criteria, the University's Visitor of Schools planned and conducted a personal visit to the applicant school. Upon completion of a successful visit, determined by the Visitor's report of the condition of the school building, qualified teachers efficiently instructing their classes, of the school's or department's organization, of teaching loads, of student discipline, of library facilities, and the overall appearance and spirit of the school and its students, the University faculty voted to recommend affiliation of the approved subjects offered by the applicant school. The University's positive decision for affiliation increased local communities civic pride and offered enhanced prestige not only to the local high school but to the community as well.[9] The first year of this program, 1885-1886, four high schools acquired affiliation in the subjects of English, Latin, history, and mathematics. By the 1917-1918 school year, the affiliated schools, in various subjects, numbered 231.[10]

Not all high schools in the state applied for affiliation. Certainly, not all that requested affiliation acquired it. Throughout the extensive affiliation records, now housed in the Center for American History, The University of Texas at

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[9] Bulletin #106, 5-7.

[10] Bulletin of the University of Texas at Austin, #1825, Catalogue of the University of Texas, 1917-1918, May 1, 1918, 445-450.

Austin, many files, such as one for the high school in Olney, contain only one letter from a school district requesting the applications.[11] Many files however contain voluminous correspondence. Some schools received affiliation only to lose it when they failed to maintain the university affiliation standards.[12] For example, the Odessa High School received affiliation on April 23, 1914, based on the strength of its faculty and its procurement of adequate financial support. The following January 21, 1915, after a subsequent visit, the University withdrew the school's affiliation because it was not organized on a departmental plan, some teachers lacked standard teaching practices and some teachers loads included seven daily recitations. In addition, the Affiliation program recommended a maximum of six course recitations and the school had added no additional teachers as specified in the affiliation decision the previous year.[13]

The affiliation program of the University of Texas at Austin brought academic standards and organization to the high schools of Texas. Without this effort, the state's schools' secondary curriculum likely would have continued to be chaotic and confused, a characteristic of many high schools, particularly rural high schools in the late 19th century and early 20th centuries. The affiliation system also provided guidance to local superintendents and school boards in their

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[11] Olney Affiliated High School Papers, (Center for American History Affiliated School Records, Box 4P310).

[12] Odessa Affiliated High School Papers, (Center for American History Affiliated School Records, Box 4P310).

[13] Odessa Affiliated High School Papers, (Center for American History Affiliated School Records, Box 4P310).

formulation of policy about educational conditions, curriculum, methods of instruction, textbook usage, and assessment of student performance.[14]

Many influences inside and outside the state of Texas affected this affiliation program, a means toward standardization of high school education. One, certainly, was the period's rapid change in commerce and the growth of cities. Another was the development and spread of new ideas in educational theory and practices. Public attitudes toward education also changed and an increasing number of Texas communities wanted secondary education for their youth. Another major influence was the report, in 1893, of the National Education Association's Committee of Ten.[15] After the committee studied the problem of standardization and possible improvements of the work of secondary schools, this notable report attracted immediate national attention and support. The appearance of the report coincided with the public high school's emergence as the nation's principal secondary education institution. Indeed, this report enunciated the basic purposes and established the pattern of secondary education in the United States that continues to prevail.[16] This report also directly influenced the affiliation requirements of the University of Texas.

The Committee of Ten Report formulated four models of course work for the nation's secondary schools, the Classical, the Latin-Scientific, the Modern

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[14] Karon LeCompte, Larry Kelly, and O.L. Davis, Jr. "*Seeking Standards: Mathematics and Science Curricula for Early 20th Century Texas High Schools*". Paper in Revision.

[15] John Addison Clement, Principles and Practices of Secondary Education (New York, The Century Co., 1925): 221-223.

[16] Frederick Raubinger, The Development of Secondary Education, (New York, Macmillan, 1969): 25.

Language, and the English. With the exception of the Classical course, the other courses allotted almost one-fourth of the total time to the natural sciences. The Classical course sequence integrated physical geography in the first year, physics in the second, no science in the third and chemistry in the fourth year. The Latin-Scientific, the Modern Language, and the English courses all offered the natural sciences in an identical sequence. The student in these three courses started their first year with physical geography, the second year with physics and botany or zoology, the third year with astronomy and meteorology and chemistry, and the fourth year with geology or physiography and anatomy, physiology and hygiene. It is interesting to note that the natural science courses that took up to one-fourth of the allocated school time were relative new courses in the curricula to three of the courses.[17]

The Committee of Ten disapproved of short-term courses, only one semester duration, and recommended that every subject be taught for a period sufficiently long to ensure real benefit to the student. For example, small high schools often loaded their curriculum and their teachers with physiology, physical geography, botany, geology, chemistry, physics and astronomy in addition to the school's regular classical program.[18] The Report advised high schools to teach fewer science courses and to devote more time to each subject taught. The

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[17] John Addison Clement, Curriculum Making in Secondary Schools (New York, Henry & Holt, 1928): 330-331.

[18] Stuart G. Noble, A History of American Education (New York, Farrar & Rinehart, 1938): 291-314.

committee also emphasized the need for better-prepared teachers and a higher level of scholarship by students.[19]

Although common schools had worked well on the sparsely populated frontier and in small towns, they struggled in the wake of social, economic and political changes. By the end of 1918, American education however, had taken on most of the characteristics it has today, i.e., grade levels, subject offerings departmentally organized, textbooks, teacher certification, free public education through the twelfth grade, and courses for college bound students as well as courses that provided preparation for the job market after graduation from a high school. By extending the common school to include the high school, states enabled masses of students to be educated. From the turmoil of the late 1800's and early 1900's, a modern comprehensive system of graded schools emerged for the nation's students.[20]

Within this context, attention to The University of Texas' affiliated schools program has been mainly lost or dismissed. Consequently, focused studies of this affiliated school program promises to yield a substantial harvest. This inquiry concern was the development of the science curriculum of affiliated Texas high schools from 1886-1917.

PURPOSE OF STUDY

The statesmen of Texas who signed the Texas Declaration of Independence at Washington, Texas, on the Brazos, on March 2, 1836 declared

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[19] Drake, 235.

[20] Parkerson, 21.

that the Mexican government had "failed to establish any public system of education, although possessed of almost boundless resources (the public domain) and although it is an axiom in political science, that, unless a people are educated and enlightened, it is idle to expect the continuance of civil liberty, or the capacity for self-government."[21] As early as 1832 the Texas settlers had complained of the Mexican Government's neglect of public education. The Constitution of the Republic of Texas mandated the Texas Congress to provide by law a general system of education as soon as possible.[22]

The early citizens of the Republic Texas were sure that the Republic needed schools. Interest in public education was active and controversial. There was much discussion about the provisions for schools, should the schools be free and publicly supported by taxes or not. The Committee on Education of the Third Congress of the Republic of Texas, January 4, 1839, also delineated the definite standards of moral conduct for the teachers.[23]

Although interest and controversy existed about the many features of the 1839 report, it appears the curriculum was taken for granted. The curriculum generated little discussion or interest. It seemed the subjects to be included in the curricula were a matter of common knowledge and agreement. Teacher candidates were required by law to provide evidence of their ability to teach

[21] Eby, 79.

[22] Eby, 80-84.

[23] Eby, 153-164.

reading, writing, English grammar, arithmetic and geography furnished the only indication of what should be contained in the curriculum.

What role did the University of Texas affiliation program take in bringing structure to the state's secondary schools? What effect did the affiliation program practices, policies and procedures have on the schools? How did this affiliation process shape the development of the chemistry, physics and biology curriculum in Texas? This dissertation is an attempt to provide answers for these questions.

Chapter Two: Methodology

Historical research is the systematic and objective location, evaluation and synthesis of evidence in order to portray and develop interpretations of past events.[24] This research thus seeks to reconstruct the central events in the history of the University of Texas Affiliated Schools program and in the historical development of science in Texas' secondary school offerings. Although historical research shares some features with both normative and interpretive research--the quest for objectivity and a desire to minimize biases and distortion--it cannot meet the tests of the scientific method as understood in the physical and natural sciences. Historical research, by its very nature, cannot employ experimentation. The historian cannot be a witness to the facts they seek in ways that other researchers can. However, historical research qualifies as scientific research from the standpoint of subscription to the same principles and the same general scholarship that characterizes all scientific research.[25]

The modern historical researcher strives to insure as far as possible that interpretation of the images and documents from the past that have been

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[24] Walter R. Borg, Applying Educational Research: a Practical Guide (New York, Langman, 1999): 12.

[25] Louis Cohen and Lawrence Manion, Research Methods in Education. (London, Croom Helm, 1985): 47-48.

uncovered is as free from bias and distortion as possible. Obviously, historical documents are biased reports; however, researchers can examine them without prejudice in light of other historical evidence. Although researchers often contend with inadequate information that renders specific reconstructions a sketch rather than a portrayal, ultimately, historical research is concerned with a broad view of social, economic, and political conditions rather than only with specific details. The acts of historical research involve the identification of an area of study and the collection, organization, verification, validation, and analysis of evidence related to that inquiry. This sequence of investigation can lead to a new understanding of the past and its relevance to the present and future.[26] The values of historical research, categorized by Hill and Kerber include: (a) it enables solutions to contemporary problems using the past; (b) it brings present and future trends to light; (c) it stresses the various interactions that are found in cultures; and (d) it allows for the reevaluation of data, theories and generalizations that currently are held about the past.[27]

Primary and Secondary Sources

Because historians cannot witness past events, they must rely on documents and other remnants from the past. The collection of these documents is the fundamental stage of historical research. These documents, or source materials, classified into two categories, include primary sources, the mainstay of

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[26] Cohen, 49.

[27] Joseph Hill and August Kerber, Models, Methods, and Analytical Procedures in Education Research (Detroit, MI., Wayne University Press, 1967): 43.

research, and secondary sources, which supplements the primary data or is used in the absence of primary data.[28]

Primary sources of data include those items that are original to the problem. Two categories exist. The first one includes a given period's relics or physical artifacts (e.g., tools, skeletons, fossils, weapons, or pictures) that were not designed or constructed to transmit information to subsequent eras. The second category includes items that had a direct relationship with historical events. These items include written and oral testimony from actual participants, manuscripts, laws, archives of official minutes or records, files, letters, official publications, newspapers, magazines, maps, and catalogues. All these sources are capable of transmitting first-hand accounts of events. Historical research in the field of education depends largely on sources in this second category.[29]

Most of the primary sources for this study are located at the Center for American History, The University of Texas at Austin. The largest and perhaps the most valuable source is the Affiliated School Records compiled by the University's Visitor of Schools from 1886-1917. These records are contained in sixty-eight vertical file boxes, covering twenty-eight shelf feet and three inches. The data in the boxes hold the correspondence between university and high school administrators. This correspondence includes letters from superintendents and principals who desired information about affiliation, completed applications from high schools that list courses taught, number of recitations per week and time for

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[28] David R. Cook, and Kenneth LaFleur, N., A Guide to Educational Research, (Boston, Allyn and Bacon, 1975): 35.

[29] Cohen, 55-56.

each recitation, teachers for each course offered, their qualifications and pay. In addition, list of the textbooks used, content covered during the school year, and the numbers of students per class are included. Reports of the visitor of schools from the university, and faculty minutes that recorded University faculty action (denying and/or granting affiliation) for subjects in the high schools that applied for affiliation are also on file in these records.

Another major source are the papers of individuals. Those of William Seneca Sutton are contained in eleven vertical file boxes at the Center for American History. Sutton, appointed instructor in education at the University of Texas in 1897, became professor of education in 1905 and, in 1909, became Dean of the School of Education. Sutton organized and established summer school sessions of the university. He served as acting president of the university in 1923 and 1924, and in 1927 became dean emeritus. During Sutton's time at the university, he was integrally involved in the affiliation process. His papers contain personal correspondence asking for information about the affiliation process, at times asking for help locating a new principal or teacher for the local school system. Other collections in the CAH reasonably may relate to this project.

A third group of primary sources includes the University of Texas Presidential papers. This group is contained in two hundred seven vertical file boxes, eighty-six linear feet at the Center of American History. These files include correspondence (1886-1917) with students, principals and other school administrators who inquired about affiliation and problems that they faced. In addition, faculty reports, faculty minutes, application for positions, budgets, the new biology building updates and annual reports to the president are included.

Secondary sources do not have direct physical relationships to events, therefore are not described as original sources. Thus, a secondary source would be a description of an event by a person not actually present, who obtained the information from another person or source, which may or may not be a primary source. Examples of secondary sources important to this study include 1) textbooks used in Texas schools of the period; 2) and accounts of Texas culture, political and social history of the period; and 3) portrayals and interpretations of the expansion of American secondary education. A secondary source can contribute significantly toward valid and reliable interpretation.[30]

Other secondary sources include minutes of boards of school trustees of high schools that desired affiliation, newspaper articles from the towns involved, and around the state, school yearbooks, and reports to the State School Superintendent of Public Instruction from officials of the high schools. Newspapers provide a daily record of history and are especially valuable in indicating trends. While newspaper articles are subject to the reporter's interpretation of the events, the articles can provide valuable sources for identifying public opinions.

Evaluation of Sources

An historical researcher must analyze carefully each source, primary or secondary and attest to its worth for the particular study. Evaluation of historical

[30] Cohen, 57-58.

data commonly referred to as historical criticism, and any reliable data obtained referred to as historical evidence. Historical criticism usually contains two stages, external and internal criticism.

External criticism seeks to discover the authenticity or genuineness, of evidence, aiming at documents themselves rather than information contained therein. Researchers must first view the holding record that describes from where documents came and the process by which they were obtained. Then, historians must establish the history of the document. How did the document get in the collection? Who created the document? They must examine the circumstances surrounding it, referred to as the provenance of the document, and attempt to uncover possible fraud, forgeries, hoaxes or distortions. Does the document transmit knowledge of the time, and is it consistent with known facts about the author or the period? After researchers have established the authenticity of documents, through external criticism, they must then evaluate the accuracy and worth of the data itself that is internal criticism.

Internal criticism of any historical document must be undertaken with healthy skepticism. These documents normally do not reveal secrets easily. They require researchers to approach the document's information from different angles, suspicious of half-truths, intentional or not, and of gossip. Furthermore, the researcher must also know the characteristics of the social, economic, and political climate of the period. Several questions need asked of each document, among them, what exactly does the document mean. The literal meaning may differ from the implicit meaning. If the document is a translation from a different language, what alternate meanings of words are reasonable and have the meanings changed over time? How well suited was the author to record information or observe an event? Was the author present at the event? When, how, and to or for whom was this document made? Did a period of time elapse between the event and the written record? What was the intended purpose of this document? For what audience was the document written? Can a detectable bias in the report be accounted for? Is any specialized information such as technical vocabulary needed to interpret the document? Do recorded actions seem probable according to dictates of informed common sense? [A test of believability is that, given all the evidence, an event is probable]. Finally, do corroborating testimonies or documents exist? No document should stand by itself; additional evidence can validate the historical exhibit. No one source can provide undisputed truth.[31]

Historical research in education yields insights into some educational problems, helps individuals understand how the present educational system evolved, and can provide a solid foundation for further progress. This research can also show how and why educational theories and practices developed, thereby making the identification of these theories and practices easier and assessment of recurrent themes in educational practice and advocacy. An improved and richer understanding of the history of educational ideas should minimize the repackaging of old or discredited programs that achieve only poor results and wasted time and resources. Historical education research also can contribute to the fuller understanding of the interrelationships between politics and education,

[31] Don Carlton, Classroom Notes: Historical Bibliographical and Historical Methods, (Austin, Texas, University of Texas at Austin, Fall Semester 2000).

school and society, local and central government, and between teachers and pupils.[32]

[32] Cohen, 54-58.

SECTION TWO

Chapter Three: Historical Context for the American High School

The years between 1865 and 1918 mark the transition from an old to a modern America. During these fifty years, the young agricultural population tired to heal the wounds of the disastrous Civil War and transform itself into a leading industrial world power. The antebellum period had been a time of great territorial expansion. After the Civil War, however, expansion was no longer limited to land but reached into all areas of life. The frontier, a democratizing force in early America, officially closed in 1890. Arizona and New Mexico became states in 1912, completing the process of statehood between the Mississippi River and the Pacific Ocean.[33] The end of the 1800's witnessed the social, economic and political transformation of America.

At the beginning of the 1800's, America had been a rural, agricultural nation with the majority of its population living in the countryside, and only five per-cent of its population living in cities. The end of the Civil War accelerated the pace of migration from farms to cities. As European immigration also increased, America became increasingly urban. By the end of the nineteenth century, the

[33] Freeman R. Butts and Lawrence A. Cremin, A History of Education in American Culture (New York: Henry Holt, 1953): 253.

shift of the population was occurring at a profound rate. Mechanized agriculture had increased, minimizing opportunities for young men and women on farms and causing an estimated one third of all rural Americans to move to the growing urban centers.

Immigration from Europe continued to spiral upward, from over 500,000 persons each year in the 1880's, to over one-and-a quarter million in the early 1900's. Furthermore, the nature of individual immigrants changed. The first group of immigrants was comprised mostly of Germans, English, Norwegians, and Irish. This wave generally peaked after 1850, with a second wave extending from 1870 to 1920. The second group of immigrants included Roman Catholic and Jewish immigrants from the Austro-Hungarian Empire, Belgium, Greece, Italy, Poland and Mexico that created a growing diversity in the new urban centers.[34]

The growing multiculturalism of America's cities initiated dramatic social and political conflict and brought two important changes in education. First, led by the Roman Catholic Irish, a modern parochial school movement began. Second, public school curriculum shifted from a Protestant focus to a more secular approach to both learning and moral education. The explosive growth of the urban population had led to a new philosophy of modernism.[35]

Modernism was an optimistic belief that all our social, economic,

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[34] Donald Parkerson and Jo Ann Parkerson, Transitions in American Education (New York: Routledge Farmer, 2001): 15.

[35] Parkerson, 15.

political, medical or educational problems could be solved through the coordinated efforts of science, technology and government. It forever altered the intellectual and philosophical foundation of the nation. The field of sociology now emerged to solve our social problems by using scientific analysis. The area of modern economics also began during this era, providing an understanding of the nature of business cycles and an awareness of ways in which the population could deal with economic change. Most of the professional disciplines, such as political science and advanced medicine, were established during the last years of the nineteenth century as modernism spread into every part of society.[36]

Americans began to believe that we could eliminate disease through scientific medical research combined with professional credentials and standards for the medical profession. The American Medical Association, established during this era, helped launch eighty-six new medical schools in the United States between 1875 and 1900. In addition, the creation of new standards for medical students promoted the growing professionalism of this field. This increased focus on the medical field yielded great breakthroughs in medicine during this time. The introduction of "germ theory," new vaccines, and improved surgical techniques reinforced the professionalism of medical practitioners.[37]

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[36] Parkerson, 17-18.

[37] Parkerson, 18.

Federal and state governments also became more responsive to the needs of the American people. The Civil Service Commission, established in 1883, created a system of merit examinations to select employees for government jobs, replacing the old system of being hired simply because you "knew someone." Regulatory agencies at the end of the nineteenth century dealt with the problem of business monopolies, creating the Interstate Commerce Commission and passing the Sherman Anti-Trust Act.[38]

Industrialization also began in earnest during this time. Two important factors were involved. First, America had a wealth of natural resources. Forests provided the material for many wood products; two of the nine major known iron ore deposits in the world were in the United States; there was an abundance of copper, silver, sulfur, phosphates, zinc, lead, and other industrial minerals; and there were seemingly unlimited sources of energy from oil, coal and waterways. Second, the federal government supplied aid during and after the Civil War in the form of tariffs protecting American goods, established a national system of banking, and provided direct stimulation of the economy in the form of huge land grants.[39]

Another primary contributor to the growth of industry during these years was the growth of transportation and communication. Railroads rapidly increased, linking all parts of the growing, industrialized nation together. Fueled by its great

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[38] Parkerson, 14-19.

[39] Butts, 300.

source of raw materials and the ever-increasing supply of cheap immigrant labor, the nation turned away from its agricultural base and embraced industrialization. This period also witnessed the invention of the phonograph and the light bulb, the electricification of New York City with the launch of the Pearl Street Station, the Wright brothers' first flight in an airplane, and Henry Ford starting Ford Motor Co. with the introduction of the Model T. Not only had America witnessed tremendous growth as an industrial nation, but its educational system had also begun to change.[40]

LATIN GRAMMAR SCHOOLS, ACADEMIES AND HIGH SCHOOLS

The United States has gone through several major transitions in its educational system: first, from the Colonial Period to the end of the Civil War and then during the period from the end of the Civil War to the end of World War I. Although the colonists believed education was important, they did not share the belief that the creation of an organized system of education was imperative. The Colonial Period produced the beginnings of the Latin Grammar School that trained boys for college but failed to provide training for boys whose intentions were to become merchants and mechanics.[41]

The desire for a more utilitarian education than the grammar schools provided led to the establishment of the North American Academies, loosely based on the English dissenting academies. These new academies served two purposes: they provided a useful education and transmitted the cultural knowledge

[40] Butts, 300-301.

[41] Drake, 231.

required for acceptance into the middle class, offering social mobility for the average citizen. Although the academies were privately supported and privately controlled, either by religious groups or by local civic groups, they were considered separate and distinct from grammar schools because the academies provided a practical education. As time passed, the configuration of the academies varied from small colleges to the occasional high school. By the latter part of the nineteenth century, the academies had firmly established their identity as institutions providing secondary educations, albeit solely for the education of the elite. Even though the academy was primarily for the upper class, it nevertheless made a direct contribution from the academy to the development of the secondary high school. [42]

The city of Boston, in response to parents' complaints about having to send their students to country boarding schools or academies at their own expense, or to the Boston Latin School that offered a traditional grammar school curriculum, founded, in 1821, the English Classical School. This new school offered a curriculum typical of academies. It included English, geography, arithmetic, algebra, geometry, trigonometry, history, navigation, and surveying. In a matter of a few years, in 1824, the English Classical School was renamed the English High School, thus becoming the first high school in the United States.[43]

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[42] Butts, 261.

[43] Joel, Spring, The American School: 1642-2000 (New York: McGraw-Hill, 2001): 23-33.

HIGH SCHOOLS EXTEND EDUCATION SYSTEM

Clearly, the citizens of Boston recognized that the curriculum of the academy was a great improvement over the Colonial Latin Grammar School and that it provided a useful and practical secondary education. However, they also saw that it still failed to serve large groups of students whose parents could not afford to pay tuition, and they began to demand a school system supported by public taxes. Acceptance of the new purpose of the high school: to educate for life, rather than for college attendance, is indicated by the Massachusetts law of 1827 requiring the establishment of high schools in all cities and towns with populations of five hundred or more families. In addition, the law provided for the teaching of such subjects as bookkeeping, geometry and algebra. In spite of the Massachusetts law of 1827, the development of high schools in the Unites States was slow.[44]

With a few exceptions, most early American high schools followed the pattern of the first high school, the English High School and spread to other towns in Massachusetts, then to cities in the middle states, and west to the major cities in Ohio, Illinois and Michigan. This expansion continued at a slow pace, meeting with opposition from groups and organizations with large investments in private academies. In addition, only larger communities could provide both funds and

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[44] Noble, 180.

students in adequate numbers to justify a high school.[45] By 1860, there were an estimated three hundred twenty-one high schools in the country, but one hundred sixty-seven of these were concentrated in the growing urban areas of Massachusetts, New York, and Ohio. Several factors contributed to this slow growth. From the beginning, and for many decades later, the high school remained an urban and middle class institution. The slow development of public elementary schools in rural communities caused a belief that high school had little or no appeal for the rural farm population.[46] Funding for high schools also faced challenges.

The English High School in Boston began a new system of funding for schools: a tax-based support of public education. While the public readily accepted the appropriateness of tax support for elementary schools, the fight over public taxation for secondary education finally led to the famous Kalamazoo, Michigan, case of 1874.[47] The major issue of this case, taxation for the support of the local high school, examined the whole question of public taxation for higher education. This case, taken to the Supreme Court of the state of Michigan, heard by Chief Justice Thomas M. Cooley, set the precedent that a community maintained the right to provide a high school by taxation. The decision was

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[45] Butts, 261-263.

[46] Drake, 231-233.

[47] Drake, 234.

emphatic that the state could establish a complete system of schools, including a non-teaching Superintendent, and not limited in scope to only the common schools.[48] Justice Cooley stated, "We supposed it had always been understood in this state that education, not merely in the rudiments, but in an enlarged sense, was regarded as an important practical advantage to be supplied at their option to rich and poor alike."[49] This judgment settled the tax support issue in favor of high schools being free schools, giving constitutional legitimacy to their development. As other states followed the state of Michigan's lead, general support for public high schools advanced.

A second statement from Justice Cooley's decision, "in the direction of free schools in which education, and at their option the elements of a classical education, might be brought within the reach of all the children of the state," contains a very significant statement according to Edward Krug. Krug believed the most significant expression from Justice Cooley in the decision was the one "including elements of a classical education." As a classical education was still a prerequisite for college admission, Justice Cooley established the high school as part of an organizational system extending from the earliest elementary grades to college. These inclusions of a classical education made the high school serve two purposes: one to provide practical education and the other to prepare students for

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[48] Ellwood P. Cubberley, Readings in the History of Education. (New York: Houghton Mifflin, 1920): 587.

[49] Spring, 255.

college.[50] With its legal basis clarified, the high school had developed a permanent position in the education system of the United States.

In 1860, there were perhaps forty high schools in the United States.[51] In 1870, the number had increased to seventy. In 1890, there were two thousand five hundred; in 1910, twelve thousand, and in 1920, thirteen thousand nine hundred fifty-one. From 1890 on, the number of high schools increased by an average of more than one for every calendar day for thirty-five years. The number of pupils in 1890 was reported as 202,000. In 1918, 1,735,619 students were reported.[52] Within a single generation, the high school diploma had become the minimum level of schooling for all American boys and girls furnished at public expense for the preparation of new citizens.

Chapter Four: Affiliation Programs in the United States

The early history of the affiliation programs is a story of the efforts made by administrations both at the public high school and university levels. These efforts attempted to provide universities with academically qualified applicants and to provide high schools with access to universities for their graduates. Historically, academies still enjoyed great prestige, but their academic reputations

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[50] Edward Krug, Salient Dates in American Education. (New York: Harper & Row, 1966): 93.

[51] John W. Woodhull, "How the Public Will Solve Our Problems of Science Teaching," School Science and Mathematics (1900, IX): 267.

[52] Bureau of Education Bulletin #19 (Washington DC, 1920): 92.

depended on the personalities of the men who directed them. The fledgling high schools also relied upon their superintendents and principals for strong guidance. The curricula of both academies and the public high schools were very similar; however, the standards they imposed, their examinations, and the emphasis they placed on certain areas of the curriculum differed as much as the personalities of the men in charge causing the work of one school to be somewhat different from that of another.[53]

The public high school first existed with little or no definite relation to the university. Eastern universities regarded high school students' preparation as inferior to graduates of the academies and Latin schools, and the Western universities considered high schools little more than additions to the elementary schools below them. However, with the rapid growth of high schools, these schools slowly began to rival the academies and Latin schools in preparing students for university work, and gradually replaced them.[54] Thus, the public high school established its place in the educational system of the United States between the elementary school and the universities. To simplify the promotion and acceptance of high school graduates from schools whose standards and curriculum varied widely universities responded by requiring an examination of each student desiring admittance.

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[53] Henry H. Hill, "State High School Standardization," Bulletin of the Bureau of School Service #6 (March, 1930, Volume II): 10.

[54] Edward F. Buchner, "Phases of Modern Education," Education (June 1906 Volume XXVI): 574-575.

While high schools struggled for a standard curriculum, leading universities also maintained a great diversity in subject matter and admissions requirements. Because of students' unknown academic backgrounds, colleges established entrance examinations. The first known record of a college entrance requirement is the regulation from Harvard, begun by President Dunster in 1642. This requirement, originally in Latin, was translated to read, "When any scholar is able to read Tully or such like classical Latin Author extempore, and make and speake true Latin in verse and prose, suo (ut aiunt) Marte, and decline perfectly the paradigms of nounes and verbes in ye Greeke tongue, then may hee bee admitted into ye College, nor shall any claime admission before such qualifications."[55] Soon, most other colleges followed the lead of Harvard for some type of entrance examination. The subjects required for entrance remained predominantly Latin and Greek until the early nineteenth century, when Harvard added arithmetic as a third subject in 1807.[56] Between 1800 and 1870, eight new subjects were added to the lists of most colleges as admissions requirements. These were geography, English grammar, algebra, geometry, ancient history, physical geography, English composition, and United States history.[57] The period around 1870 marked a transition of college entrance requirements from those leading a single degree to those befitting the more diverse modern college with electives leading to multiple degrees. At this time, English, modern languages and

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[55] Edwin Cornelius Broome, A Historical and Critical Discussion of College Admission Requirements (New York: Macmillan, 1903): 17-18.

[56] Broome, 41.

[57] Broome, 42-46.

science began to appear in admissions requirements.[58] During this change, examinations continued to be the only means universities had of determining students' fitness for higher education. Not until 1870 did another plan appear for determining entrance qualifications for students.[59]

This second means of entrance to college began in 1870 when the University of Michigan introduced a system of accrediting high schools. The Acting President of the University of Michigan, Dr. Henry F. Frieze, the former Latin Chair, initiated this plan of accreditation. His plan was no doubt developed during 1856 when Dr. Frieze obtained a leave of absence to visit Europe, primarily Italy, France, England and Germany. While making observations and attending lectures at the University of Berlin, Dr. Frieze gained an appreciation for German scholarship and German methods of education. Upon his return to the University of Michigan, Dr. Frieze continued to comment on the excellence of the German gymnasia and university training. These new ideas reflected much broader concepts of the functions of the university and high school.

Dr. Frieze's plan begun in 1871 was based on the German method of receiving students into the universities from the gymnasiums.[60] This program advocated that a great university could only be built upon a foundation of much higher scholarship in the preparatory schools. It proposed admitting graduates of lower schools only after these schools had passed inspection by one or two

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58 Broome, 47.

59 Hill, 10.

60 James Burrill Angell, A Memorial Address for Dr. Henry Simmons Frieze (University of Michigan, March 16, 1890): 15-17.

members of the university faculty. Faculty members visited schools to examine courses of study, teaching methods, laboratory equipment, and library collections as well as overall discipline and spirit. Final accreditation for preparatory schools was determined by a committee of seven faculty members chaired by the President acting on the recommendations of the visiting committee. Thereafter, the University of Michigan accepted students upon presentation of a diploma, without further examination, from a properly certified or accredited school. Other students not from accredited schools could continue to acquire admission to the university upon successful completion of an admissions examination.[61]

This program by Dr. Frieze had several advantages. By sending university members to visit and inspect individual high schools at regular intervals, it drew secondary schools and the colleges closer by eliminating barriers between them. High schools were stimulated to higher quality work, and colleges began to understand the inherent problems of high schools. This system enabled students to attend the university upon completion of four years of accumulated work and not after a single examination, thereby eliminating cramming for the test or teachers concentrating instruction to prepare college-bound students for the entrance examination.[62]

This closer relationship between the university and the secondary schools stimulated the high schools to a higher level of achievement, made preparation for

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[61] B. A. Hinsdale, "Systems of Admission to Universities and Colleges," School Review (1896, Volume IV): 302-304.

[62] John Brubacher S., Higher Education in Transition; A History of American Colleges and Universities, 1636-1968 (New York: Harper & Row, 1968): 244.

the university more uniform, and raised the scholarship of all students. The high school and its superintendents, principals, and teachers looked to the visits of the examiners as occasions to compare notes, discuss policies and teaching methods, and acquire fresh motivation. The high schools actually desired more frequent rather than less frequent visits from the university, and the university benefited from the direct contact of their faculty with the high schools and their students.[63]

James Burrill Angell replaced acting President Frieze in the fall of August 1871, with Dr. Frieze returning to his position as Chair of Latin.[64] Their collegial relationship began in 1844 when James Angell was a student in Dr. Frieze's Latin and Greek classes at the University Grammar School, and continued for many years.[65] The new president, Dr. Angell, embraced the new affiliation program with high schools in the state of Michigan. In fact, President Angell's hearty support of the admission-by-diploma program enabled the program to rapidly expand. For the next twenty-five years, Dr. Angell remained chairman of the committee that directed the diploma admission program.

That first year, 1871, four schools affiliated with the university: Adrian, Jackson, Flint and Ann Arbor, for a total of fifty students.[66] The accrediting system's growth continued, and in 1876, the first change occurred. Up to that time

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[63] Hinsdale, 305.

[64] Elizabeth S. Adams, "The Administration of Henry Simmons Frieze," The University of Michigan an Encyclopedic Survey (Ann Arbor, University of Michigan Press, 1941, Vol. I): 59-60.

[65] Angell, A Memorial Address for Dr. Henry Simmons Frieze, 14.

[66] Joseph Lindsey Henderson, Admission to College by Certificate (New York City, Teachers College, Columbia University, 1912): 51.

high schools were accredited by the university only if a high school could prepare students simultaneously for all three undergraduate courses of study leading to the degrees of bachelor of arts, bachelor of science and bachelor of philosophy. In 1876, the committee decided that encouraging schools to train pupils fully in one or two courses was superior to forcing schools to produce more variety of poorer quality. After this decision, high schools still received accreditation even though they were unable to prepare students for all the curricula offered at the university.[67]

By 1880, the program's success was evident as sixteen of the most important high schools in the state were included, increased numbers of Michigan high schools had applied, and the plan had spread to secondary schools in other states. These developments led the faculty committee to recommend that the privileges granted to schools in Michigan be extended to high schools in other states. The regents approved this extension to out-of-state high schools in 1884, and within a year high schools from New York, Illinois, Minnesota, and California had availed themselves of the privilege of sending students on diploma to the University of Michigan. In 1891, President Angell reported that diploma relations with high schools were so firmly established and the benefits so obvious, that it was wise for the university to assume the expense of sending faculty committees to visit the high schools of Michigan.[68] By 1889, there were 187

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[67] George C. Carrothers, "The Bureau of Co-operation with Educational Institutions," The University of Michigan an Encyclopedic Survey (Ann Arbor, University of Michigan Vol. I, 1942): 317.

[68] Carrothers, 317-318.

schools in fifteen different states sending their graduates to the University of Michigan by diploma.[69]

To further enhance the emerging bond and continue to raise the academic standards of the state's high schools, the university initiated, in 1879, the Department of the Science and the Art of Teaching. In conjunction with the establishment of the Department of the Art of Teaching, the president urged and the regents approved, the establishment of the first permanent chair devoted exclusively to the professional training of teachers in any American university.[70]

This new idea of university admission initially engendered fears of lower scholarship among incoming freshmen; however, after nine years, a comparison study was made of the records of students admitted both by examination and from accredited high schools. The study revealed no significant difference in their performance as students at the university. Furthermore, the accreditation plan created closer ties between the university and the high schools.[71] The University of Michigan's program helped upgrade the state's high schools and allowed their graduates to enter the university as freshmen without further examination. High school graduates of accredited schools could look forward not only to automatic admission to the university, but also better preparation for higher learning. High schools sought university accreditation and boasted of it. Community spirit from

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69 Broome, 117.

70 Allen S. Whitney, "The Administration of James Burrill Angell," The University of Michigan an Encyclopedic Survey (Ann Arbor, University of Michigan, Vol. I, 1942): 66.

71 Willis F. Dunbar, The Michigan Record in Higher Education (Detroit, Wayne State University Press, 1963): 135.

the citizens, school board, principal and the superintendent, ran high and a feeling of competition between communities immerged. Communities whose high schools failed to achieve University approval could not ignore the failure. These high schools had to try to raise standards.[72]

Several other important innovations also began as part of this diploma program. The requirement that all high school graduates qualify for admission to all three of the university's undergraduate schools changed to allow students to meet the requirements of only one undergraduate program. Thus, high schools could now provide higher quality instruction in fewer programs rather than attempt to cover a multitude of programs only superficially. Additionally, the establishment of the permanent chair and the creation of the Department of the Art of Teaching provided the state's high schools with more highly qualified teachers. Certainly, the success of this programs innovations presented a guide for other states to follow.

Other states quickly followed the University of Michigan's lead. By 1887, the University of Minnesota voted to accept students on certificate from schools in other states, providing their own state universities accredited the schools, suggesting the spread of the certification program.[73] Individual states subscribed to the basic idea of admitting high school graduates to universities by diploma versus examination, but each state's program contained different variations.

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[72] Howard H. Peckham, The Making of the University of Michigan 1817-1992 (Ann Arbor, University of Michigan Press, 1997): 73.

[73] Henderson, Admission to College by Certificate, 64.

The state of Indiana created a state board of education as a political organization with state officers. However, it became an educational body, which included the governor, the Superintendent of Public Instruction, the President of Indiana University and the superintendents of schools from the three largest cities in the state, in 1865. This board in 1873 passed an order that students should be admitted to the freshmen class on certificate from certain schools to be named by the board. This board created a roster of commissioned schools from a list of schools visited by board members, and became the first outside agency to designate the schools from which certificates would be received.[74] In 1885, accreditation became directly dependent upon the personnel of each high school. The State Board of Education published a circular in the University Catalogue for 1884-1885 stating that changes in superintendent, principal, or course of study were sufficient reasons for withdrawing affiliation. Schools were required to submit evidence by January 1 each year that no changes had occurred.[75]

The University of Illinois began a program of admission by certificate two years after the University of Michigan. The Illinois program involved examinations supplied by the University and administered by county school superintendents. The county superintendents issued the certificates upon successful completion of the tests. This program brought about a new development in which instead of university faculty, instructors, or a general board, one man that had little knowledge of university standards and no personal

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[74] Buchner, 579.

[75] Henderson, Admission to College by Certificate, 63.

knowledge of the student, was entrusted with the certification process.[76] In 1876, the university added to the County Superintendent's Certificates, a high school principal certificate permitting principals to examine and certify high school graduates.[77]

Finally, the university, in 1877, began a program called "Examining Schools." Certain schools in each county designated by university faculty, could now prepare questions and conduct entrance examinations to be evaluated by university faculty. A second new program began that year with a list of "Accredited High Schools" prepared by the university. These accredited high schools could now also examine and certify students for admittance to any of the state's colleges.[78]

By the 1890's, the accreditation program of the university had become a time-consuming project. The number of accredited schools in Illinois had risen from fifty in 1888 to more than 150 by the late 1890's. While a few faculty members visited high schools, primary responsibility for visitation fell to the professor of pedagogy Dr. McMurry, which eventually led to his resignation.[79] A new element was added to the visitation programs when special examiners who were members of the university faculty received supervisory status.[80]

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[76] Henderson, Admission to College by Certificate, 54-55.

[77] Henderson, Admission to College by Certificate, 57.

[78] Henderson, Admission to College by Certificate, 57-58.

[79] Henry C. Johnson, Jr., Teachers for the Prairie: The University of Illinois and the Schools, 1886-1945 (Chicago: University of Illinois Press, 1972): 77-78.

[80] Henderson, Admission to College by Certificate, 72.

Another modification of the initial Michigan plan began about 1887 in California when regents endorsed the visitation program on March 4, 1884, after much discussion by the faculty on the merits of a certification system. Those who feared it would lower the standard of admission raised considerable opposition to such a plan. They asked if the student is really prepared for university courses, why should they not show it by examination. Those who supported a visitation program pointed out that such programs had been successful at other universities, such as Michigan, with good results. It was their further belief that this program offered an opportunity to bring high schools into a closer relationship with the university.[81] The new program at the University of California instituted a faculty committee.

The faculty committee appointed from various colleges of the university conducted the task of accreditation. Examiners, generally six to fifteen men visited the secondary schools, which had made application, both public and private, in all parts of the state.[82] Their visit involved more than just one or two professors dispatched to determine the general condition of a high school in a brief visit. Every leading department of study: English, mathematics, science, history and classics, sent representative faculty members who spent considerable time in individual classrooms, often testing the progress of the students

[81] Martin Kellogg, "Admission to College by Certificate," Educational Review (Volume V, January-May, 1893): 384.

[82] Leon J. Richardson, "The University of California and the Accrediting of Secondary Schools," School Review (Volume X, 1902): 615-617.

themselves. These inspections, repeated annually, continued the certification from year to year.[83]

The faculty committee received from the examiners written reports on every subject in the high school. In addition, the high school would send student specimen papers in all subjects under inspection yearly. Toward the end of each academic year, the faculty committee published the accredited list, showing not only the accepted high schools but also the subjects within each school that had met the accreditation standards. The university did not simply accept students without administering entrance examinations. Rather the principals of each accredited high school applied for university admission in behalf of their students. In a brief sixteen years, the number of accredited high schools increased from three in 1883 to one hundred ten in 1899.[84]

These accreditation systems, while creating new methods of college entrance for high school graduates, also engendered closer relationships between a state's university and its high schools. Higher standards in high schools, that led to higher qualifications among incoming college freshmen, were the direct results of these accrediting programs.

THE UNIVERSITY OF TEXAS BEGINS THE AFFILIATION PROGRAM

When the University of Texas was founded in 1883, only eight public high schools existed in the state.[85] The first high school had opened in 1879 in the

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[83] Kellogg, 385.

[84] Richardson, 616-618.

[85] Frederick Eby, The Development of Education in Texas (New York, Macmillan, 1925): 247.

central Texas town of Brenham.[86] Although the university accepted 221 students for its initial class, either by examination or by faculty approval, professors judged most of them as ill prepared for university work.[87] Realizing that the lack of standards for the state's high schools would hinder the growth of the university into a first class institution, the university catalogue of 1883-1884 contained the first reference to a high school affiliation program. The catalogue stated, "It is designed, as soon as practicable, that a diploma from the approved high schools shall admit the student, without examination, to all the privileges of the University."[88]

The following year, the annual faculty report reveals that the university faculty had investigated plans used by other universities. It inquired,

> Is it not possible for the University to avail itself now of the schools already established in the State, so as practically to secure the services of some of them in fitting students for the Freshman Class. It is believed that this can be done in the case of certain High Schools by the offer to admit their graduates to the University under certain conditions without examinations. This is the plan adopted by the University of Michigan, and its practice in that institution has been attended with marked success.[89]

The faculty continued to recommend adoption of the Michigan plan of admitting students without examination from accredited high schools, provided these high schools adjusted their course work to meet the requirements for admission to the University of Texas.

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[86] "Brenner Banner," Brenham, Texas, August 20, 1875 (CAH, UT-Austin).

[87] Bulletin #106 (April 1, 1908): 5-7.

[88] University of Texas Catalogue (1883-1884): 7.

[89] University of Texas Annual Faculty Report (1884-1885): 8.

The Board of Regents of the University of Texas adopted the plan of affiliation as suggested by the faculty on June 15, 1885, with the following comment; “The valuable suggestion of the Faculty as contained in their report - as to a system of subsidiary high schools throughout the State as feeders to the University - said system to consist in the selection of high schools upon a principle of visitation and examination by a committee of the Faculty was adopted - the details of the system being left to the Faculty.”[90] The faculty determined that local school boards could request affiliation, and that a committee designated by the university faculty, would visit the school. If competent instructors taught at the school and the courses included the requirements for admission to the University, then the graduates of the high school would be admitted without examinations.

This new program was published in the University of Texas Catalogue, 1884-1885 and minutes of the Faculty, September 14, 1885, state that the high schools of Austin, Ball of Galveston, and Round Rock had asked for affiliation. It was ordered that the graduates of Austin High School be admitted to the University without examination and that this privilege be extended to graduates of the last school session.[91] Following the establishment of this new admission program, university enrollment began a steady increase each year. By the school year 1895-1896, two developments at the university renewed its effort to further the affiliation of the state’s high schools. The first President had been elected that

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[90] Minutes of the Board of Regents of the University of Texas (1885, Vol. A): 135.

[91] University of Texas Faculty Minutes (1885, Vol. 1): 114.

transferred responsibility of university control from the faculty. Second, and perhaps the most important factor, the School of Education was formed in 1897, with W.S. Sutton as Professor of Pedagogy.[92] Sutton formed a Committee on Affiliated Schools to establish criteria that included eligible curricular subjects, faculty qualifications, building quality, suitable classrooms, appropriate textbooks and adequate laboratory facilities. This action created the first academic standards for public high schools in the state of Texas.[93]

THE UNIVERSITY OF TEXAS AFFILIATION PROCESS

The affiliation process began with a high school administrator's request for affiliation. In response to this request, applications, or "blanks" as they were called in the letters of correspondence, were sent to the requesting school. After submission of completed affiliation applications to the University's Committee on Affiliated Schools, the administrator subsequently was requested to submit student specimen papers (e.g., laboratory manuals of experiments completed, student-written examinations from Latin, English, mathematics and history courses, and writing journals) for review and grading by university faculty (specific to the papers under review). If the faculty in each specific area judged that the student papers met affiliation criteria, the university's Visitor of Schools planned and conducted a personal visit to the applicant school.

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[92] Joseph L. Henderson, Educational Memoirs of Joseph Lindsey Henderson (Austin, Texas, Von Boeckmann-Jones, 1940): 139.

[93] Bulletin #106 (April 1, 1908): 5-7.

The Visitor investigated the condition of the school building, the qualifications of the teachers and how efficiently they instructed their classes, the schools or department's organization, of teaching loads, of student discipline, of library facilities, and the overall appearance and spirit of the school and its students. If his report indicated that a school met the agreed upon standards, then the university faculty voted to recommend affiliation on the approved subjects of the applicant school. The university's positive decision for affiliation increased local communities' civic pride and offered enhanced prestige not only to the local high school but to the community as well.[94] In the first year of this program, 1885-1886, only four high schools received affiliation in the subjects of English, Latin, history, and mathematics. By the 1917-1918 school year, 231 schools received affiliation in various subjects.[95]

Not all schools in the state applied for affiliation, and certainly not all that requested affiliation acquired it. Throughout the extensive affiliation records housed in the Center for American History, at The University of Texas at Austin, many files, such as ones for the high schools in Olney, contain only a single letter from a school district requesting the applications.[96] A considerable number of files however contain voluminous correspondence. Some schools received affiliation only to lose it when they did not continue to meet the university standards. For example, Odessa High School received affiliation on April 23,

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[94] Bulletin of the University of Texas at Austin #106, 5-7.

[95] University of Texas Catalogue, 1917-1918 (May 1, 1918): 445-450.

[96] "Olney High School Papers," Texas Affiliated Papers, Box 4P310 (CAH UT-Austin).

1914, based on the strength of its faculty and its procurement of adequate financial support. After a subsequent visit the following January 21, 1915, the university withdrew the school's affiliation for the following reasons: it was not organized on a departmental plan, some teachers lacked knowledge of standard teaching practices, and some teachers' loads included seven daily recitations. The affiliation program recommended a maximum of six course recitations, and the school had added no additional teachers as had been specified in the affiliation decision the previous year.[97]

Many influences inside and outside the state of Texas affected its affiliation program, as a means toward standardization of high school education. One factor, certainly, was the period's rapid change in commerce and the growth of cities. Another was the development and spread of new ideas in educational theory and practices. Public attitudes toward education were also changing and an increasing number of Texas communities wanted secondary education for their youth. Another major influence was the 1893 report by the National Education Association's Committee of Ten.[98] Its study of the problem of standardization and possible improvements in the work of secondary schools, attracted immediate national attention and support.[99]

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[97] "Odessa High School Papers," Texas Affiliated Papers, Box 4P310 (CAH UT-Austin).

[98] John Addison Clement, Principles and Practices of Secondary Education (New York: Henry & Holt Co., 1925): 221-223.

[99] John Addison Clement, Curriculum Making in Secondary Schools (New York: Henry Holt & Co., 1928): 330-331.

Secondary schools at this time were in an anomalous condition. High school and academy programs offered forty different programs, arranged in no logical order. Courses were offered with no regard either to the studies that preceded them or to subsequent courses. Many more were properly elementary studies. Subjects were taught differently to college-bound and non college-bound pupils. Only a few isolated schools offered laboratory methods in science teaching. Many courses offered merely brief, short studies, containing only basic information and devoid of any real training or disciplinary character. With such a diversity of programs in the high schools and great dissimilarities among college entrance requirements, only a few high schools could afford to maintain the number of classes required for college entrance. As a result, only three per cent of high school graduates entered college.[100] The Committee of Ten report enunciated the basic purposes of secondary education in the United States and established the pattern of implementation that continues to prevail.[101]

The Committee of Ten Report formulated four models of coursework for the nation's secondary schools: the Classical, the Latin-Scientific, the Modern Language, and the English. With the exception of the Classical course, almost one-fourth of total instructional time was allotted to the natural sciences. The Classical course sequence integrated physical geography in the first year, physics in the second, no science in the third and chemistry in the fourth year. The Latin-

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[100] James C. MacKenzie, "The Course for Academies and High Schools Recommended by the Committee of Ten," The Independent (New York, Volume XLVI, July 5, 1894): 984-985.

[101] Frederick, Raubinger, The Development of Secondary Education, (New York, Macmillan, 1969): 25.

Scientific, the Modern Language, and the English courses all offered the natural sciences in an identical sequence. Students in these three courses started their first year with physical geography; the second year with physics and botany or zoology; the third year with astronomy and meteorology and chemistry; and the fourth year with geology or physiography and anatomy, physiology and hygiene. It is interesting to note that the natural science courses that took up to one-fourth of allocated school time were relatively new courses in the curricula in three of the four models.[102]

The recommendations from the Committee closely resemble the programs of European secondary schools, although no references were mentioned. Both the Prussian gymnasium and the French *Lycee* closely resemble the American high school. While differences certainly existed, it is clear that the Committee of Ten's programs, especially the classical programs, were on a par with their European counter parts.[103]

The committee disapproved of short-term courses, lasting only one semester, and recommended that every subject be taught for a period of sufficient length to ensure real benefit to the student. For example, small high schools often loaded their curriculum and their teachers with physiology, physical geography, botany, geology, chemistry, physics and astronomy in addition to the school's regular classical program.[104] Such high schools were advised to teach fewer

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[102] John Addison Clement, Curriculum Making in Secondary Schools (New York, Henry & Holt, 1928): 330-331.

[103] MacKenzie, "The Course for Academies and High Schools Recommended by the Committee of Ten," 1894.

[104] Noble, 291-314.

science courses and to devote more time to each subject taught. The committee also emphasized the need for better-prepared teachers and a higher level of scholarship by students.[105]

Although common schools had worked well on the sparsely populated frontier and in small towns, they struggled in the wake of social, economic and political changes. In response, by the end of 1918, American education already had taken on most of the characteristics it has today: i.e., grade levels, subject offerings organized into departments, state approved textbooks, teacher certification, free public education through the twelfth grade, and courses for college bound students as well as courses that provided preparation for the job market after graduation from a high school. By extending the common school to include the high school, states enabled masses of students to be educated. From the turmoil of the late 1800's and early 1900's, a modern comprehensive system of graded schools emerged for the nation's students.[106]

The affiliation program of the University of Texas at Austin brought uniform academic standards and organization to the secondary high schools of Texas. Without this effort, the state's secondary school curriculum would have continued to be chaotic and confused, a characteristic of many high schools in the late nineteenth century and early twentieth centuries. The affiliation system also provided guidance to local superintendents and school boards in their formulation

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[105] Drake, 235.

[106] Parkerson, 21.

of policy about educational conditions, curriculum, methods of instruction, textbook usage, and assessment of student performance.[107]

Within this historical context, of the growth of secondary school systems, attention to The University of Texas' Affiliated School Program has been lost or dismissed. Consequently, a focused study of the affiliated School Program promises to yield a substantial harvest. This inquiry's focus is an examination of the archives housed at the University of Texas at Austin, which reveal the development of the Affiliated School Program and especially follow the evolution of the science curriculum in the Texas secondary high schools from 1886-1917.

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[107] LeCompte and Kelly (Paper in Revision, 2002).

SECTION THREE

Chapter Five: Science Curriculum Development in American Education

SCIENCE DEVELOPMENT IN THE UNITED STATES

The scientific center of Western civilization has shifted progressively from Italy in the 1500's, to England in the 1600's and early 1700's, to France in the late 1700's and early 1800's, to Germany in the century from 1860 to 1930 and finally to the United States since the 1930's. America's rise to scientific prominence required a full century, from about 1840 to 1940.[108]

Eighteenth century science's primary focus on assumptions of the laws of nature, in particular, those asserted by Sir Isaac Newton, were sufficient to account for the phenomena of the physical world such as the motions of the moon and planets. In the nineteenth century, science's important question related to Charles Darwin's formulation of evolutionary theory and whether or not the earth and its inhabitants were created miraculously according to Biblical accounts only a few thousand years ago or evolved over periods of millions of years. These questions involved biology and geology.[109]

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[108] Larry I. Bland, "The Rise of the United States to World Scientific Power, 1840-1940," The History Teacher (November 1977, Vol. XI): 77.

[109] Michael, Shortland, Teaching the History of Science (Oxford, England, Basil Blackwell Ltd., 1989): 59-60.

Biology, at the beginning of the nineteenth century, designated the study of properties common to living organisms and specific to them. The first explicit biological endeavor in the United States, the Philadelphia Biological Society began its work in 1857. The middle decades of the century saw the inclusion of botany and zoology in “natural history.” Loosely tied to botany and zoology were various health-related studies such as anatomy, physiology and hygiene. Biology became a substantive university area in the United States between the 1870’s and the 1910’s. For example, Harvard, in 1871, had a life science department that included botany, zoology, and physiology. Biology became an important unit in American high schools during the first decades of the nineteenth century and rapidly replaced the more specialized subjects of botany and zoology. Indeed, biology became the most widely taught course in American secondary school science programs.[110]

Botany began early in the colonies. Concerned laypersons became interested in the collection and cataloging of the area’s flora. They hoped to discover spices, medicines, food, timber sources and other economically beneficial plants. The knowledgeable Europeans were interested in learning about botanical observations and specimens, whether live or preserved. After the American Civil War and the publication of Darwin’s *The Origin of Species* botany became a professional occupation. Botanical education in America had begun as a haphazard mix of courses, but during the nineteenth century, botany became a popular school subject, and as a result, entered the college curriculum.

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[110] Marc Rothenburg, <u>The History of Science in the United States</u> (New York, Garland Publishing, 2001): 80-81.

In particular, botany found a home in the land grant colleges, and was considered an adjunct to agriculture.[111]

The history of chemistry in the United States began in the Massachusetts Bay Colony. In 1631, the son of its first governor brought chemicals, apparatus, and books from England and established the first chemistry laboratory and scientific library. Chemistry emphasized the composition and clarification of the meaning of elements, compounds and combustion. In the early nineteenth century, the United States, with its vast mineral resources, began a long period of descriptive and analytical chemistry. The lack of apparatus, manpower and public interest hindered additional work until President Thomas Jefferson appealed to the American public to support chemists' work in the useful science. By the beginning of the nineteenth century, universities had established separate courses in chemistry, changing it from one component of the natural philosophy course into a full-fledged academic subject.[112]

The practice of physics began in the United States with two amateur societies: the American Philosophical Society founded in Philadelphia in 1769, first proposed by Benjamin Franklin in a letter dated May 14, 1743,[113] and the American Academy of Arts and Sciences, AAAS, organized in Boston in 1780. These two societies initiated research in natural philosophy, as physics was then known, but the AAAS members still relied on European colleagues for

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[111] Rothenburg, 89-91.

[112] Rothenburg, 114-116.

[113] Albert Henry Smyth, The Writings of Benjamin Franklin (New York: Macmillan, 1907): 229.

institutional and conceptual support. Colleges during this time included courses in natural philosophy, but Harvard's Lawrence Science School, founded in the 1840's, and Yale's Sheffield School, opened in the 1850's, began to offer particular technical fields as professional disciplines, including physics. Near the mid-century, the traditional label of natural philosophy gave way to the increasingly popular label of physics. By the 1880's, Johns Hopkins University also encouraged specialization by awarding PhD's in the sciences. Even secondary schools and academies began to reflect this trend by offering physics in the 1880's and 1890's. By the closing of the nineteenth century, physicists were starting to move beyond rudimentary and inadequate offerings of the science in colleges and secondary schools, matching their counterparts in France, Germany and England.[114]

Building on the early interest in the sciences of a few colonists, the sciences became firmly established in the secondary schools and universities of the nation. For science to become a profession, research facilities, funding, and career opportunities were needed, with higher education as the most popular source.[115]

HISTORY OF SCIENCE EDUCATION

The public school movement gathered momentum in the early 1800's and culminated in the establishment in most states of tax supported, free public schools. During the early periods of education in the United States, there was little

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114 Rothenburg, 437-439.

115 Bland, 76.

need by the masses of people for book learning and little economic demand for education. Few letters were written in this simple agricultural period after the Revolutionary War, seldom did one need to sign his name, newspapers as we know them today did not exist, and the inability to read or write was in no way anything to be ashamed of. It was not until the end of the War of 1812 that a national consciousness based on the rise of manufacturing, trade and industry turned America's attention to the creation of a democratic system of education for the people.[116] This period eventually witnessed a marked drive toward a greater degree of specialization among, and expansion of, individual sciences. These developments failed to affect the nation's schools, however, because the accepted model of school remained the European-oriented classical program of studies.[117] For admission to most universities, the classical languages were doubtless the only important qualification. Harvard did not even require backgrounds in mathematics until 1803.[118] However, all nine of the colonial colleges, Harvard, Yale, Princeton, Columbia, William and Mary, Brown, Dartmouth, Philadelphia and Rutgers included natural philosophy in their basic course of study, with professorships in this field established at six of the colleges by 1766.[119] Natural philosophy usually covered the general properties of matter, mechanics, optics,

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[116] Ellwood P. Cubberley, <u>An Introduction to the Study of Education and to Teaching</u> (New York, Houghton Mifflin Co., 1925): 6-7.

[117] David Tassel and Michael Hall, <u>Science and Society in the United States</u> (Homewook, Illinois, Dorsey Press, 1966): 28-29.

[118] Theodore Hornberger, <u>Scientific Thought in the American Colleges, 1638-1800</u> (Austin, Texas, The University of Texas Press, 1945): 19.

[119] Frederick Rudolph, <u>The American College and University</u> (New York, Knopf, 1962): 30.

electricity, magnetism and astronomy and supplemented studies in Latin, Greek, Hebrew, logic and rhetoric which continued to form the core of studies.[120] Natural history commonly referred to studies in zoology.[121] Science finally became a component of the curriculum at universities during the last half of the eighteenth century, and was increasingly emphasized during this period of social and intellectual change. Because individuals should become intelligent about the common phenomena of their environment, and since nature was orderly, rational, and therefore capable of being understood, the study of science was justified. Once understood, nature could be manipulated and controlled for the benefit of man.[122]

In the case of secondary education, college entrance requirements dominated the emerging high school and shaped its curriculum to emphasize Latin, Greek and classical studies. The high schools responded by compelling all their students mainly males, to take the classical studies whether or not they intended to continue studies at college. This practice resulted in a common understanding that the high school was an exclusive institution supported by the many for the benefit of the few. In a sense, this general feeling had legitimacy. Although the early high schools accepted all students, they were almost exclusively white and essentially closed to individual youth who desired a practical education that prepared them for work after high school graduation. The

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[120] Tassel, 165.

[121] Hooker Worthington, M.D., Natural History for the Use of Schools and Families (New York, Harper & Brothers, 1874): ii.

[122] Tassel, 165.

public high school struggled for existence, having to compete with academies for students and operating under different curriculum philosophies. While the academies primarily prepared students for college entrance examinations and then college entrance, or the classical curriculum, the public high schools introduced an education that, in addition to college preparatory classes, provided training for students destined for jobs after high school graduation, or a "practical" education. The development of public education carried a strong motive to provide an education for more than just the few college bound students.[123]

During much of the period that the academies flourished, some academies offered instruction in subjects that would be considered elementary. However, some academies had become well established, enabling these schools to offer instruction in subjects that were on the university level. Nevertheless, the majority of academies offered a wide range of subjects.[124] Among these subjects, the sciences were offered early in the curriculum. The academies in New York first offered botany in 1827, chemistry in 1825, physics in 1879 and zoology in 1828.[125] While the academies offered this wide variety of sciences, forces outside the education system such as changes in the economy, social life, and political beliefs, began to demand a change in the public school curriculum to one of a more practical value, which prepared students for the workplace.[126] Changes came

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[123] Alexander Inglis, Principles of Secondary Education (Boston: Houghton Mifflin Company, 1918): 186.

[124] William Marshall French, American Secondary Education (New York, The Odyssey Press, 1967): 73.

[125] French, 74-76.

[126] J. Minor Gwynn, Curriculum Principles and Social Trends (New York, Macmillan ,1960): 5.

slowly. Schools were resistant to change because of social conditions, the weight of tradition, economic conditions, organizational structure, changes in the size, age, and nature of the school population, political upheaval, and the influence of special interest groups.[127]

Public education was supported by several publications at the time, one, Popular Education in 1833 stated, "diffusion of knowledge among the mass of mankind is the grand feature of the present age. The history of the nineteenth century will be a history of the effects of popular education."[128] Science was specially mentioned in an article from 1838 which stated that science had been the chief source of the great accumulations of capital in modern times and a great promoter of civilization.[129] Finally, the North American Review in 1841 stated, "every teacher should be acquainted with the elements of natural science, with something of Natural History, Natural Philosophy, and Chemistry. There is not a day in school which might not be enlivened by the description of some natural object."[130]

This momentum for the inclusion of science in the curriculum included several other periodicals and speeches, propelled by new technology becoming

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[127] John Hardin Best, Editor Historical Inquiry in Education (Washington D.C., American Educational Research Association, 1983): 139.

[128] No author, "Popular Education," North American Review (University of Northern Iowa, Cedar Falls, Iowa, Volume 30, Issue 67, 1833): 73.

[129] No author, "Influence of Knowledge upon Social Well-Being," North American Review (University of Northern Iowa, Cedar Falls, Iowa, Volume 47, Issue 101, 1838): 293.

[130] No Author, "Massachusetts Common School System," North American Review (University of Northern Iowa, Cedar Park, Iowa, Volume 52, Issue 110, 1841): 172.

linked with patriotism. Science education provided the foundation for these new technologies. Americans had acquired the belief that technological independence was being won, followed by world supremacy that was inevitable for a free and democratic people.[131] Science men in Europe reported in 1822 that they "were astonished at the rapidity of American discovery and improvement."[132] America had previously borrowed and copied much that was valuable from Europe; now Europe was borrowing and copying from America.[133] Another editor urged in 1865 that, "We ought to be doing something to keep up our reputation for running faster, flying higher, diving deeper, and coming up drier, than all other people in creation."[134] An address by the president of the Society for the Promotion of Engineering Education in 1898 reinforced the attitude that the efficient direction of any industry demanded a large amount of technical knowledge that could not be learned at the workbench or in the shops as apprentices once did.[135] Newspapers added efforts to popularize the sciences with interesting facts in columns and editorials. Editorials from newspapers encouraged popular interest

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[131] Hugo A. Meier, "American Technology and the Nineteenth-Century World," American Quarterly (University of Pennsylvania, Philadelphia, Volume X, No. 2, Part 1, 1958): 117-122.

[132] Extracts of a Letter from Wm. McClure to Editor, "Progress of American Science–Madrid, December 4, 1821," American Journal of Science (New York, Volume V, 1822): 197.

[133] "Report of the Select Committee Appointed to Take into Consideration the State and Condition of the Patent Office," Mechanics Magazine and Register of Inventions and Improvements (New York, Volume VII, Number 6, June, 1836): 330.

[134] Editorial, "A Sensation Wanted," American Artisan Volume II (December 27, 1865): 121.

[135] John B. Johnson, "President's; Address: A Higher Industrial and Commercial Education as an Essential Condition of Our Future Material Prosperity." Proceedings of the Sixth Annual Meeting of the Society for the Promotion of Engineering Education (Society for the Promotion of Engineering Education, Boston, Massachusetts, Volume VI, 1898): 16.

and speculation about science.[136] The Chicago Tribune was one paper that used its editorial page to promote the value of the sciences.

The Chicago Tribune contained several editorials adding to the demands to include a practical education in the public high schools. One in 1890 asserted that too much, "cruel, one-sided, and eternal cramming" combined with too much book learning of Latin and Greek in lieu of American studies was failing of public schools. "The classics have their place, but that place should be a subordinate one," to ones with practical bearing and the principal aim of the schools should be to "turn out young Americans and not young Greeks and Romans."[137] Another in 1899 stated, "The first function of a high school is as a finishing school and not as a preparatory."[138]

The Scientific American also joined the discussion on the importance of classical studies. In one weekly edition in 1872, an editorial stated that "not only are physics and mechanics more pleasant studies that Latin, and chemistry more interesting than Greek grammar," but physics, mechanics and chemistry were far more practical studies for the job market.[139] Another editorial in the following month declared "The custom of a so called classical training is simply a relic from

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136 Donald Zochert, "Science and the Common Man in Ante-Bellum America," ISIS (The Smithsonian Institution, Washington, D.C., Volume 65, Number 229, December 1974): 452.

137 Editorial, "The Kaiser on the Classics," Chicago Tribune (Chicago, December 14, 1890): 12.

138 Editorial, "What High Schools Should Teach," Chicago Tribune (Chicago, July 16, 1899): 34.

139 Editorial, "How to Conduct New Scientific Investigations," Scientific American (New York, Volume XXVI, No. 22, May 25, 1872): 351.

the middles ages, when there did not exist anything worth studying."[140] In the same year, 1872, another editorial suggested that the study of science had become so powerful due to the social conditions that opposition to its study was "utterly useless."[141]

These editorials from the Scientific American, added to by some from the Chicago Tribune eleven years later continued the debate over the worth of a classical education. The Tribune in 1883 ran two editorials, one titled "The Greek Language, Humbug," strongly criticized the subject and teachers of Greek. The paper expressed the opinion that Greek was one of the "greatest educational time consuming abuses of the age," and that making Greek a necessary requirement for college admission and thus a compulsory study in the high schools, was a humbug maintained only to provide occupations for a few Greek professors.[142] This was followed by one more editorial expressing the idea that Greek was only useful to those who taught it.[143] Following public opinion, public high schools altered their curriculum by offering liberal arts courses suited to the needs of more of the nation's youth, and the high school became successful.[144] Undoubtedly, newspapers, books, public addresses and periodicals created a public demand for

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[140] Editorial, "A Plea for Common Sense," Scientific American (New York, Volume XXVII, No. 2, July 13, 1872): 28.

[141] Editorial, "The Appreciation of Knowledge," Scientific American (New York, Volume XXVII, No. 7, August 17, 1872): 103.

[142] Editorial, "The Greek Language Humbug," Chicago Tribune (Chicago, June 30, 1883): 4.

[143] Editorial, "Waste of Time on Greek," Chicago Tribune (Chicago, October 29, 1883): 4.

[144] S.O., Hartwell, "The Relation of the High School to the Elementary School and to the College," School Review (Vol. XI, 1901): 167.

a wide range of scientific information, and as a natural extension, an addition to the public school systems.

Undoubtedly, the study of humanities is one of the most valuable in any curriculum, but college work continued to emphasize Latin and Greek into the twentieth century. The study of literature in English, both English and American, was almost non-existent in most colleges. The Latin Grammar School, still very formal and college entrance oriented, contrasted with the early academies. These early academies began to provide an extensive curriculum that covered a number of new subjects that had value for the changing conditions of life and society rather than just mean preparation for college. These new subjects had practical benefit to the pupils whether attending college or entering the work force.[145] One of the earliest academies, the Cheshire Academy, introduced the natural sciences with laboratory apparatus in 1801.[146] The Phillips Academy proposed that liberal arts and sciences be a part of the curriculum.[147] Inglis further stated that the Phillips Academy in 1818 offered studies in two departments, the Classical Department and the English Department. The Classical Department curriculum was almost identical to the Boston Latin School. The English Department included in the third year elements of chemistry and natural philosophy with experiments as part of the curriculum.[148] It is of interest to note the "elements of

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145 Inglis, 178.

146 Editorial, "Schools as They Were Sixty Years Ago," American Journal of Education (Chicago: University of Chicago Press, Volume 17, April 1868): 558.

147 Inglis, 178.

148 Inglis, 179.

chemistry and natural philosophy with experiments" was an early attempt to equate the usefulness of chemistry with that of physics, or natural philosophy. The acceptance of chemistry as a recognized science of importance was not to be until the post-Civil War period.[149]

As the academy became more firmly established, the offerings became more varied. Among the courses that were added to the curriculum were science courses. Inglis, in 1837, reported that in the State of New York, academies added more than seventy-five subjects of which thirteen could be classified as part of the physical or biological sciences.[150] The book Harry and Lucy, published in 1813, encouraged children to study science by presenting chapters about thermometers, globes, microscopes, air pumps, and barometers. These references included uses and experiments that readers might investigate with the apparatuses. This book was intended for young people between the age of ten and fourteen to encourage them to study mechanics using scientific apparatus.[151]

These new science courses were seen by the classical trained academies as intellectual usurpers, and they made concessions only when forced to. The first universities were not science oriented so the schools preparing their students for college saw no need to teach science.[152] This period, the last half of the nineteenth

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[149] Sidney Rosen, "The Rise of High School Chemistry in America to 1920," Journal of Chemical Education (Volume 33, December, 1956): 627.

[150] Inglis, 180.

[151] Maria Edgeworth, Harry and Lucy (Boston: Cummings & Hilliard, 1813): 91-92.

[152] Michael D. Stephens, "American and English Attitudes to Scientific Education During the Nineteenth Century," Annals of Science (New York, Volume 30, December, 1973): 438-439.

century, witnessed the science disciplines growing and expanding. New sciences and sub-sciences emerged. Higher mathematics became an integral part of the physical sciences. New skills, instruments and techniques became important to the natural sciences. Modern sciences were taking shape as distinct studies.[153] The many branches of science known today were just developing or gaining a foothold in the curriculum at that time.

The last half of the nineteenth century also saw a phenomenal rise in the acceptance and uses of science in the school curriculum. These concessions to the sciences were in a large measure attributable to Herbert Spencer, who saw in the reforming educational ideas of Rousseau, Pestalozzi, Herbart, and Froebel the core, a common denominator for a useful practical education. Spencer's question, "What knowledge is of most worth?" served as a rallying point for educational reform. Spencer asked, "How to live? – That is the essential question for us." Spencer continues, "the great thing which education has to teach. To prepare us for complete living is the function which education has to discharge: and the only rational mode of judging of any educational course is, to judge in what degree it discharges such function."[154] The educational courses of any curriculum would then present man with a choice from among the subjects of study, but the relative value of any course or knowledge would be directly related as it favors the

[153] Hamilton Cravens, "American Science Comes of Age: an Institutional Perspective, 1850-1930," American Studies (Lawrence, University of Kansas, Volume XVII, No. 2 Fall 1976): 50.

[154] Herbert Spencer, Education: Intellectual, Moral, and Physical (Paterson, New Jersey, Littlefield, Adams & Co. 1963): 30-31.

exercise of those essential activities that contributed to both individual and social happiness.[155]

Spencer applied the criterion of relative value, and in answer to the question about determining the knowledge of most value to man, he replied that it was science. Obtaining the essentials of life makes use of those sciences, which aid man to be gainfully employed. Included among these sciences were chemistry, mathematics, physics, biology, and sociology.[156] French reiterated the views of Spencer when he wrote that Spencer believed that science was, "par excellence, the important subject in education of the nineteenth century."[157] Spencer answers the first question as he wrote, "Thus to the question with which we set out – What knowledge is of most worth? -the uniform reply is – science. This is the verdict on all counts. And for the purposes of discipline intellectual, moral, religious, -the most efficient study is, once more –Science."[158]

The effect of Spencer's writings had great influence on the curriculum and educational practices of the last twenty-five years of the nineteenth century. Education was no longer to be purely for the classicists, but was to be based upon superior scientific knowledge for the complete life of the learner. Spencer also was instrumental in helping create a place for the modern sciences in the college curriculum. Acceptance of the sciences as an integral part of the college

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155 Gabriel Compayré, Herbert Spencer and Scientific Education (New York, Thomas Crowell & Co., 1907): 27.

156 Spencer, 58.

157 William French, American Education (New York, Odyssey Press, 1955): 126.

158 Spencer, 63-64.

curriculum occurred first, and then an elective system of subjects was instituted in the public secondary schools.[159] As new knowledge increased in both pure and applied sciences, the curricular science content of natural history and natural philosophy was no longer feasible or desirable in secondary education. From natural history there evolved botany, zoology, paleontology, physiology, anatomy, and other natural sciences. From natural philosophy there evolved astronomy, physics, chemistry, geology, mineralogy, meteorology, and other physical sciences.[160] The writings of Spencer placed a premium on educational experiences in the present and in subjects, which are useful in the present.

Perhaps the most profound contribution by Spencer was the awakening in educational thought that the activities of one's life would contribute to one's existence as a responsible citizen, one of preparation for life.[161] The writings of Spencer placed a premium on educational experiences in the present and in studies that are useful in the present. Science was now due a place of preeminence in the universities and schools, which it did not possess yet.[162] Though the classicists immediately began a defense for what they felt was their rightful place in the curricula, based on mental discipline and transfer of training, Spencer had created a place for modern subjects in the curricula.[163]

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[159] Inglis, 507-508.

[160] Butts and Cremin, 348-349.

[161] Lawrence A. Cremin, The Transformation of the School; Progressivism in American Education, 1876-1957 (New York, Alfred A. Knopf, 1961): 92.

[162] W.H. Wynn, "The New Education," The National Teacher (October, 1871, Volume I): 527.

[163] William M. French, Education for All (New York, The Odyssey Press, 1955): 41-42.

Gradually, science courses crept into most well equipped high schools as the new twentieth century dawned. The first high school, the English Classical High School of Boston, established in 1821, included natural philosophy as an offering, and the state of Massachusetts began to require natural science of all its graduates in 1847.[164] As these changes in curriculum were underway in the high schools, colleges were compelled to admit students who had studies quite different from the formal classical studies on which the colleges had been founded. Needing a supply of new students each year that had different qualifications, colleges necessarily began the modification of their courses and entrance requirements. The struggle for the high school curriculum to benefit all students became one of great influences in changing the educational system of the United States.[165]

The new courses in high school curriculum witnessed science becoming central to secondary education. First taught in academies, often to both women and men, natural philosophy, (physics), physiology, chemistry, botany, and, at times geology and zoology, finally appeared in the high school curriculum in the mid 1800's. Sciences were added to or deleted from the curriculum because of changes in various aims or points of view that determined the selection of course material and its organization. The first view, which survived from the older schools and was still evident in 1860, was the religious view. Although it held little weight, references continued to be made to it in prefixes of textbooks. A

[164] Clement, 328.

[165] Hartwell, 169.

second view expressed the value of knowledge, truth for truth's sake, enabling the learner to be regarded as an intelligent person. In that light, science emphasized the importance of the practical utility, or the practical aspect of the subject matter itself. The third view professed that science offered more than useful knowledge; it provided training for the mind, taught logic and reason, and sharpened the powers of observation.[166] The period from 1860 to 1900 witnessed the steady growth of physics classes, the gradual decline of geology and astronomy and the increase in class number of biology, botany and zoology.[167] Science finally had a proper place in the curriculum, due in part to the urgings of scientists themselves, notably, Thomas Huxley, Herbert Spencer, Charles Lyell, Michael Faraday, John Tyndall, and Charles Eliot.[168]

An expanding nation with bountiful resources eagerly embraced scientific studies as useful or practical knowledge. The classicists held that science promoted materialism, whereas advocates of a liberalized curriculum called Latin teachers aristocrats.[169] Scientists had to be careful when promoting the utility of science always to present the sciences as having higher virtue and not simple materialistic value.[170] Even Horace Greeley commented in his 1869

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[166] John Elbert Stout, The Development of High School Curricula in the North Central States from 1860 to 1918 (Chicago: University of Chicago, 1921): 148.

[167] Stout, 72.

[168] George E. DeBoer, "Scientific Literacy: Another Look at Its Historical and Contemporary Meanings and Its Relationship to Science Education Reform," Journal of Research in Science Education (August 2000, Volume 37, No., 6, 2000): 583.

[169] William F. Reese, The Origins of the American High School. (New Haven, Yale University Press, 1995): 107-108.

[170] DeBoer, 583.

autobiography about the absence of sciences, “ that such homely sciences as chemistry, geology, and botany were never taught despite their inestimable value.”[171] Greeley regretted the absence of science instruction in his own youth.[172]

The study of sciences introduced students to the scientific method of discovery. Through science, students learned to gather data, construct relationships, conduct observations and testing, and to develop theories. Most science texts expressed the utility of chemistry, while astronomers discussed maritime navigation and geologists improved mining and agriculture. High schools needed time to firmly establish the sciences in the curriculum, with physics remaining the jewel in the science curriculum.[173]

HISTORY OF TEXAS SECONDARY SCHOOLS

The state of Texas school system developed similarly to other states. The first schools were the Latin grammar schools, followed by academies and finally public high schools. In the state of Texas, as in other Southern states, schools were not well developed before and certainly during the Civil War because slavery and its natural hindrances and the absence of a strong middle class delayed rapid development of a public education system in the South.[174] After the Civil War, state political control shifted to a group of radical politicians, Northern

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[171] Horace Greeley, Recollections of a Busy Life (New York, J.B. Ford and Co. 1869): 56.

[172] Greeley, 57.

[173] Reese, 107-108.

[174] Edgar W. Knight, Public School Education in North Carolina (New York, Houghton Mifflin Co., 1916): 158-159.

sympathizers that were affiliated with the Federal government in Washington, D.C. A report in 1870 stated that Texas was “the darkest field educationally in the United States.” The radicals pointed out that after thirty years not a state-supported school existed in Texas; a full generation of children had progressed to adulthood without the benefit of a public school education.[175] While earlier state constitutions, in 1836 and 1845, made provisions for public education, their intent went unrealized. The first step taken by the radicals was to rewrite the state constitution in 1869, followed by a new school in 1870. These new laws required for the first time a uniform system of public free schools for all children between the ages of six and eighteen. Because its authors were so unpopular, most communities ignored its provision for setting up schools, so a stronger law was written in 1871. These new school laws provided for a state board of education with the power to select textbooks, create a salary scale for teachers, established directors for each of the thirty-five school districts, select a board of education for each district, levy taxes for support of maintenance and construction of school districts, and enforce attendance at the public schools. There was immediate antagonism against the taxes, compulsory attendance and the powers of the state superintendent. Collection of taxes for the education of other families’ children was believed to be robbery and confiscation. The compulsory attendance law also created opposition to the new school law. The Texas people believed that compulsory attendance laws did not belong to school systems for the free people of America. Six year olds were too young to attend schools in a state that had no

[175] Eby, 157.

roads and where bandits still attacked at will. Eighteen year olds were still needed on the farms. The function of schooling, in the eyes of Texas citizens, still rested with parents.[176] In 1873, Southerners regained control of state politics, writing a new school law that eliminated many provisions of the 1872 school law. Attendance declined, and many parents again elected to send their children to private schools. By the end of the school year in 1874, public education in Texas was again chaotic.[177] The following year, 1875, a state convention again attempted to rewrite the education law. Opinions were still varied, often extreme. Some delegates did not believe in public education in any form. Others wanted a highly centralized system. The resulting compromise bill became inadequate to create an efficient school system, providing no state supervision, insufficient financing and eliminating compulsory attendance.[178] However, there were individuals with influence that would change public attitudes about education.

By 1884, the efforts of Governor Oran M. Roberts, later to be influential in the establishment of The University of Texas in 1883, Dr. Barnas Sears of the Peabody Educational Board, and Dr. Rufus C. Burleson, the president of Baylor University, finally resulted in a changed public attitude about public education, enabling a new education law in 1884. This new law established the fundamental components of an educational system that provided for the election of a state school superintendent and both state and local taxation for the support of public

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[176] Eby, 163-164.

[177] Eby, 157-168.

[178] Eby, 169-176.

schools. Numerous problems still required the attention of state lawmakers from 1885-1900. Rural schools still felt discrimination, hardly any new school buildings had been built constructed before 1870, and the state did not supply textbooks until 1897. Although giant strides were made during these years in getting its education system firmly established, it was not until about 1900 Texas with its own education system in order, had time to be concerned with schools outside of Texas and around the world.[179]

With the state education law firmly established, teachers and administrators in Texas began to attend conventions, institutes, and summer courses in the North and East where they became aware of the thinking of such men as Francis Parker, William T. Harris, G. Stanley Hall, and John Dewey. Additionally, the University of Texas reestablished, in 1897, the Department of Pedagogy along with a similar department at Baylor University. Teacher training began in the program of what is now Texas Women's University, and two new normal schools were established.[180]

THE UNIVERSITY OF TEXAS BEGINS AFFILIATION PROGRAM

Many of the universities and colleges during the last twenty-five years of the nineteenth century had academies or preparatory schools of their own. The "new" high school began to be known as the "people's" college. High schools were developing independently of private universities, except for the few state supported universities by 1880. With no college responsible for the establishment,

[179] Eby, 181-197.

[180] Eby, 214-220.

support, or development of the public high school, and with the high school tax supported, private colleges undoubtedly experienced some concern over their control over entrance requirements.

The public school authorities also undoubtedly found themselves between two opposite opinions over the purpose of a secondary education. On one side, the colleges demanded an increasingly strict curriculum as preparation for college entrance. While on the other side, local public opinion demanded more immediately useful subjects. Thus, subjects not normally found in college entrance requirements found their way into the high school curriculum. The rapid expansion of high schools, from forty in 1860 to 14,326 in 1920, combined with ninety-one per cent of all eligible pupils attending secondary schools in 1920, it followed, inevitably, that these new subjects would be offered to colleges in satisfaction of entrance requirements.[181]

These new subjects, offered by the public high schools, created three methods of entrance colleges were now compelled to consider: accept the studies as presented, accept the student with conditions, or revise the entrance requirements. The first two were not acceptable for most colleges. If the college accepted a student that did not meet all the requirements, then that action would be a tacit admission that the requirements as expressed were meaningless, causing a loss of respect for the college. Admittance with conditions proved impracticable. The wholesale admission of students with conditions would create a burden for the college both in expense and in the accompanying difficulty with

[181] Bureau of Education Bulletin 1924, No. 35 "The Trend of College Entrance Requirements 1913-1912," (1935): 35.

administration and records. Although a few students were admitted with minor conditions, this practice did not become widely used. The last choice quickly became the most reasonable and practical for college entrance. With colleges in competition for students, a change in entrance requirements to accept previous education in subjects not included before was necessary. With the domination of the private colleges ending, these colleges could no longer exert any influence on the curriculum of the public high school.[182]

During the late nineteenth-century, states established more state universities. The new state universities centered attention upon and created a demand for a closer coordination between the public high school and higher institutions of learning. Finally, there existed a complete state supported system for students. The state of Texas joined the other states by creating the University of Texas in 1883, completing state supported education from elementary schools to universities.

THE SCIENCES IN TEXAS HIGH SCHOOLS

As the last decade of the nineteenth century began, new subjects were being added to the high school curriculum. Many educators believed that the addition of new subjects had created a chaotic condition in the high schools.[183] The Committee of Ten, created in 1892, one of the first attempts to promote some uniformity in the curriculum, struggled with four different issues. First, the

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[182] Bureau of Education Bulletin 1924, No. 34-36.

[183] Diane Ravitch, Learning From the Past (Baltimore: Johns Hopkins University Press, 1995): 169.

conflicting interests of the classical curriculum and modern academic subjects like science, history, and modern foreign languages. Second, how could colleges promote uniformity in preparation of students for college while also encouraging colleges to accept the modern subjects for college entrance? Third, how to accommodate some educators, demands for inclusion of practical courses like manual training and fourth, should high schools offer different curricula for college bound students and those not college bound?

The Committee of Ten report, while controversial in later years, did effectively change standards at both universities and high schools. The report recommended that modern academic subjects should be equal to the classical curricula: that neither Latin nor Greek was necessary for college preparation, but that students should be allowed to choose their subjects, as long as they included English, mathematics, history, science and foreign language. The Committee of Ten also took a firm stand for all students, stating that any taken by the student, should be taught in the same way and to the same extent to every pupil, concluding that high schools did not exist for the purpose of preparing the students solely for university work. Further, the curriculum should be the same regardless of the destination of the student, whether college or the job force. In practical terms, high schools continued teaching curricula that would prepare students for college entrance, believing that the same curriculum was the best preparation for the student to become an active citizen[184] Still, only about nine per cent of the students entering public schools graduated from high school. This

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[184] Diane Ravitch, 170-171.

small percentage indicated that many students were dissatisfied with the curriculum. Many pupils still wished training were available for an occupation after formal schooling and not for admittance to a university.[185] Clearly, the public high school curriculum needed changes, and the debate between classical over practical continued. Would education be classical in nature for all students, regardless of their future, in preparation for university work, or would modern subjects be included for students headed for the job market?

Dr. W.S. Sutton, Professor of Pedagogy and Chairman of the Affiliated Schools at the University of Texas, in a speech in 1901, set the tone for the curriculum for high school students in Texas. Sutton stated that the curriculum of the modern secondary school should be patterned after the ideals of modern life, while not ignoring the past, but that modern civilization needed to be a determining factor in the formation of the curriculum of the modern secondary school.[186] The demand for new modern subjects became so strong that they gradually were added to the curriculum, with the natural sciences included. So much of modern life was based on the discoveries of science with modern industry and business dependent upon the efficient performance and practical knowledge of some branches of science, that an education without any knowledge of science was "unpractical and absurd as it would be without any knowledge of the three R's."[187] Science was a valuable part of education not only for its

[185] Ruth Mary Weeks, The People's School (New York, Houghton Mifflin, 1912): 1.

[186] William Seneca Sutton, Problems in Modern Education (Boston, Sherman, French & Company, 1913): 53-54.

[187] F. Hodson, Editor, Broad Lines in Science Teaching (London, Christophers, 1911): 3.

practical value but also as an important element in general culture. Exciting new scientific developments were taking place that transformed societies' ideas about most other subjects as well as applied to all branches of enquiry.[188]

Three early exciting developments took place in the world of science during the last few years of the nineteenth century and the first twenty years of the twentieth century. Mendeleeff created the first periodic table by arranging the elements in order of the weights of their atoms in 1871. W.K. Roentgen first discovered X-rays in 1895, and J.J. Thompson discovered the three parts of an atom, the negative electron, the positive proton and the neutron.[189] It seems, however, that the growth of science in general had more of an impact on education than any one particular scientific event.

The sciences continued to grow in popularity in the high schools, although particular science subjects fluctuated in popularity. The percentage of schools offering physics grew from five per cent in 1860 to ninety-five percent in 1896-1900. Chemistry was offered in eighty-five per cent of the schools and dropped to sixty-five per cent in 1891-95. Zoology began with a twenty per-cent participation in 1860-1865 and grew to forty two percent in 1896-1900.[190]

Science entered education when the public became cognizant of its importance to the industrial and economic growth of the country. The impact of changing scientific knowledge on science education increased as the years

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[188] F. Hodson, 8-9.

[189] Watson Davis, The Advance of Science (New York, Doubleday, Doran & Company, 1934): 43.

[190] Stout, 72.

progressed. The sciences had now become an established part of the curriculum in schools.

The curriculum in Texas schools included science for many years. An advertisement in the Houston, Texas, newspaper, the Morning Star provided one of the earliest records of science in the curriculum. The Quintana Academy in Houston placed an advertisement that included among the curricula taught, chemistry, philosophy and botany, with the facilities and the location of the school being of great advantage for natural science.[191] Another Texas town, Clarksville, also contained an advertisement for the Pine Creek Female Institute. This advertisement, in 1842, listed astronomy and chemistry among the curricula.[192] Other schools that opened later also offered science classes. St. Joseph's College for boys in Brownsville, Texas, listed in the local newspaper chemistry and natural philosophy as subjects available.[193] Again, in 1895, the local newspaper listed, as part of the science curriculum at St. Joseph's College, natural philosophy.[194] All of the modern subjects had achieved a place in the curriculum of the high schools. The University of Texas began to realize the necessity of adding modern subjects to those accepted for entrance.

When the affiliation program began in 1886, and continuing until 1902, only four subjects were targeted for affiliation: mathematics, history, English, and

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[191] Morning Star Newspaper (Houston, Texas, April 8, 1839,Volume 1): 2.

[192] Northern Standard Newspaper (Clarksville, Texas, September 3, 1842): 3.

[193] Daily Cosmopolitan Newspaper (Brownsville, Texas, Volume Ten, August 29, 1884)

[194] Daily Lower Rio Grande Newspaper (Brownsville, Texas, Volume II, No. 636, November 26, 1895).

Latin. The university affiliation committee at first discouraged Texas high schools teaching “new” science courses by favoring only classical academic subjects (e.g. English, Latin). The UT professors of the time contended that few Texas high schools were prepared to teach science courses because most of them did not have adequate equipment, separate laboratory rooms, or qualified teachers. A letter from W.S. Sutton, Chairman on Affiliated Schools, dated September 16, 1898, to the superintendent of the Honey Grove, Texas, school offers several suggestions, one of which concerned the science courses. Honey Grove had only three years of work for students, and the school was attempting to teach physics, physiology, zoology, botany, geology, and chemistry. Sutton stressed that the school should consider dropping some of the sciences to concentrate on a few instead of attempting this wide range of topics.[195] Additionally, in March 1904, Professor Sutton wrote to the Superintendent of Schools in Crockett, “Very few small towns have secured affiliation in the natural sciences.”[196]

For almost twenty years, the teaching of sciences in Texas high schools was a controversial issue in the university’s Committee on Affiliated Schools. Moreover, although some high schools in the state offered science courses, visitors commonly observed that the quality of science offerings simply was too low for affiliation with the university for entrance credits. The committee held that the offering of too many sciences, although what type and how many were

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[195] Letter W.S. Sutton to F. M. Bralley (Affiliated School Records Archives, Center for American History, Vertical File Box 4P302).

[196] Letter W.S. Sutton to Crockett Superintendent (Affiliated School Records Archives, Center for American History, Vertical File BoxP295).

never specified, might result in failure in all studies. Consequently, the committee considered science courses to be electives only and believed that Texas high school students would benefit more from in-depth instruction in fewer rather than in many science courses. Not until nine years after the Committee of Ten Report did the Committee favor offering affiliation in a few science courses and other "modern" courses (e.g. modern foreign languages).

In September 1902, following expressions of dissatisfaction by high schools in the state, the University Affiliated Schools program offered affiliation for courses in French, German, Spanish, botany, chemistry, physics, physiography, physiology and civics, thus bringing the University of Texas into harmony with the view towards inclusion of modern subjects.[197] Most of these subjects had been taught in the better high schools for fifteen years or more. In most cases they were poorly taught, especially the sciences, because lack of laboratory facilities necessitated lessons from textbooks, memorization and recitations. Eby states that the university was tardy in accrediting these subjects. If the university had granted earlier acceptance for college entrance of these subjects, the courses would have been subjected to the affiliation process, creating better methods of teaching them. This delay created the communities' belief that the university was only interested in the public high schools as "preparatory schools" for college.[198] Although some high schools offered science classes earlier, chemistry and physics appear as the first affiliated science courses in the

[197] Sutton, Letter Crockett Superintendent, 67.

[198] Eby, 257-258.

1901-1902 school year, fifteen years after affiliation began. The following year, 1902-1903, the program added botany, physiography, and physiology.[199] Zoology first appeared as an affiliated subject in the 1908-1909 school year.[200] Subsequently, biology did not become an affiliated subject until the 1914-1915 school year,[201] and courses in general science were affiliated in 1916-1917.[202] This study will focus on the subjects of chemistry, physics, botany, zoology and biology.

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199 University of Texas Bulletin, Catalogue of the University of Texas, 1901-1901 (June 1, 1902): 312.

200 University of Texas Bulletin, Catalogue of the University of Texas, 1908-1909 (February 1, 1909): 455.

201 University of Texas Bulletin, Catalogue of the University of Texas, 1913-1914 (January 20, 1914): 557.

202 University of Texas Bulletin, Catalogue of the University of Texas, 1916-1917 (April 20, 1917): 488.

Chapter Six: First Standards for Affiliation of Science Courses

FIRST STANDARDS FOR AFFILIATION OF SCIENCE COURSES, 1905

During the opening years of the 20th century, the Committee on Affiliation, decided to offer direct advice to schools that sought affiliation of science courses. It provided suggestions concerning the teaching of each science subject. These suggestions appear to indicate that the Committee members believed that too many high schools were high schools in name only and that instruction and achievement in these schools were of such poor quality that it properly belonged in the elementary schools. The committee noted that schools should provide only those courses that contributed to a very rich, robust overall high school curriculum. It also stressed that students in high school science courses must recognize processes rather than only isolated facts.

The committee insisted on daily teacher recitations of forty to forty-five minutes each. It also observed that the teachers' workday should not consist of continuous recitations, but that all teachers should have a "vacant" or free period during which they could correct written work, assist students needing special attention, and create plans for future class work.

Following the lead of Charles W. Eliot, Harvard University President, which suggested that the most important improvement in educational methods during the past twenty years was the substitution of the laboratory method for the book method in teaching natural sciences, the committee called special attention to the importance of laboratory work in connection with natural science courses.[203] The laboratory method finally enabled the natural sciences to compete with other subjects as a discipline. The laboratory, according to the Committee, was an absolute necessity for the proper study of science, and the use of textbooks exclusively would be delusionary to students. To assist the high school faculty in attaining affiliation, members of the university faculty prepared and published a bulletin, High School Bulletin #47 "Questions Concerning Courses of Study and Methods of Teaching in High Schools," for the first curriculum standards in each natural science class in 1905.[204]

Botany

W.L. Bray, U.T. Associate Professor of Botany, suggested that the study of botany should be included in the curriculum for three reasons. First, botany possessed life and job training value. It encouraged the powers of observation and discernment, increased the dexterity of the student, and enabled the student to witness the progression from simple beginnings to countless forms of great diversity and complexity. Second, botany encompassed the state's largest resources. Cotton, cereals, lumber, fruit, grasses and garden products supported the state's economy. Third, the course required only a moderate expense for organization and maintenance due to the abundance and easy availability of materials.

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[203] Charles W. Eliot, "Undesirable and Desirable Uniformity in Schools," Educational Reform: Essays and Addresses (NEA July 12, 1892): 299.

[204] University of Texas Bulletin, 47, Questions Concerning Courses of Study and Methods of Teaching in High Schools (July 1, 1905): 3.

The specific requirements for affiliation in botany included one full year of instruction with a minimum acceptable class time per week of two class exercises of forty-five minutes each and two laboratory periods of ninety minutes each. The committee's recommended schedule suggested two class periods of forty-five minutes each and three laboratory periods of ninety minutes each weekly.

Laboratory equipment suggested for use in the course included two separate lists of laboratory equipment: Estimate A for Liberal Equipment and Estimate B for Very Moderate Equipment, both listed in Table 1.

Estimate A:

1. Special laboratory room well lighted with water and gas connections if possible.
2. Five laboratory tables, each seating four pupils, one drawer and locker per pupil.
3. Ten compound microscopes at $30.00 each.
4. Twenty dissecting microscopes at $3.00 each.
5. One wall case for instruments and supplies.
6. Standard section of herbarium case.
7. Twelve to twenty feet of shelving for aquariums, jars, cultures and standing experiments.
8. Glassware, pots, germinating trays and other utensils for growing specimens and for experiments.
9. Standard chemicals and preserving fluids.
10. Plant press, drying and pressing paper and collecting box.
11. A set of reference books.

Total estimate cost of all equipment $530.00.

Estimate B:

1. Regular recitation room and desks used for laboratory exercises.
2. Special case of drawers and shelves for supplies.
3. Twenty dissecting microscopes home made.
4. Utensils for growing class material.
5. Jars for preserved specimens and preserving fluids.

6. Outfits for pressing plants furnished by students.
7. Set of reference books.

Total estimate cost of all equipment
$55.00.

Table 1: Estimate A and Estimate B Botany Lab Equipment[205]

Chemistry

According to H.W. Harper, a U.T. Professor of Chemistry, chemistry although an elective course, could possess as much educational value as any other subject. Physics, dealing with the physical properties of matter and of phenomena connected with heat and electricity, preceded chemistry, in the high school curriculum. Chemistry offered students direct education in observation techniques and correct induction. It also provided first-hand information about well-known materials and the principles of their manufacture and properties. Chemistry students' observations included laboratory work completed on an individual basis.

Each pupil recorded observations and interpretations in a notebook. Beginning at an early stage in the course, simple quantitative experiments illustrating the laws of definite and multiple proportions, the determination of combining and equivalent weights, and the specific gravity of gases were included. Harper and the Committee recommended a minimum of six exercises during each session. Specified chemistry laboratory equipment included desks with gas and water connections, bottle racks, and well-ventilated hoods. Students should have their own sets of apparatus. Laboratories should provide every six

[205] Bulletin of the University of Texas 11 "High School Bulletin," (July 1, 1905): 66.

pupils a balance with case and weights. Additional apparatus included barometers, thermometers, burettes, porcelain crucibles and a bottle aspirator for each student. A competent teacher could have manufactured some of the apparatus called for by the use of a blowpipe, glass tubing, and a few pieces of platinum wire.[206]

To be considered competent for instruction in chemistry, a high school teacher needed preparation in several sciences with a minimum of one year in physics, one year in general chemistry, two terms (of 12 weeks each) of qualitative analysis, one term of quantitative analysis, one term of theoretical chemistry, and one term of organic chemistry. In addition to the class work, the teacher should have some acquaintance with the history of science. In the affiliation suggestions, the qualifications of the teacher held primary importance; adequate laboratory equipment was second and a modern textbook was of third importance.[207]

Physics

Physics gained early prominence in affiliation; indeed, it quickly gained standing on a par with all other subjects and became a vital high school offering. The Committee on Affiliation, through W.T. Mather, U.T. Associate Professor of Physics, recommended that lectures and recitations in high school courses be combined with frequent illustrations in order for students to develop proper conceptualization of the principles of physics. The combination of an adequate textbook, simple apparatuses for demonstrations, and regular quizzes would

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[206] Bulletin 11,72.

[207] Bulletin 11, 72.

provide adequate instruction to the student; however, the Committee believed that high school students could not obtain a proper understanding of physics without individual laboratory practice. No amount of careful classroom work could compensate for the absence of individual laboratory work. In fact, if adequate laboratories could not be provided, physics should be eliminated from the high school curriculum.[208]

Physics experiments, furthermore, should possess several characteristics. First, they should compel close observation while developing some skill and self-reliance in the student. Second, each exercise should contain the basis for the development of a generalization or should verify a previously deduced principle. Third, students should be able to reach a conclusion with little assistance; and fourth, experiments must be distinctly quantitative in character and verifiable to a reasonable degree of accuracy. To record these experiments, students had to maintain a notebook containing concise statements of:

1. The problem solved, with reference to page of manual used.
2. Apparatus used.
3. Necessary formulas and computations.
4. Observed results, together with inferences drawn from the experiment.

Consideration for affiliation of physics courses specifically required the following items: five school periods of at least forty-five minutes each per week for the entire school year, at least two laboratory practice periods per week, a high-grade textbook, numerical problems assigned as homework, and individual

[208] Bulletin 47, 82-85.

laboratory practice. Students conducted at least thirty-five experiments from the following list.[209]

Mechanics and Hydrostatics

1. Measurement of the volume of a regular body.
2. Volume of an irregular body by displacement.
3. Mass of unit volume (density) of a substance.
4. Pressure due to weight of liquids.
5. Lifting effect of water on a solid entirely immersed in it (Archimedes principle).
6. Specific gravity (S.G.) of a solid that will sink in water.
7. S.G. of wood by means of sinker.
8. S.G. of a liquid by the S.G. bottle.
9. S.G. of a liquid by its buoyant action.
10. S.G. of a liquid by balancing columns.
11. S.G. of air.
12. Boyle's Law
13. Pressure of the atmosphere (Torricelli's Exp.).
14. Laws of accelerated motion.
15. Law of the parallelogram of forces.
16. Parallel forces.
17. Coefficient of friction.
18. Action and reaction elastic collision.
19. Law of the inclined plane.
20. Mechanical advantage of the pulley.
21. Laws of the pendulum.

Sound

22. Velocity of sound in air.
23. Number of vibrations of a tuning fork.
24. Wavelength of sound by resonance tube.
25. Laws of vibration of a stretched string.

Heat

26. Testing a mercurial thermometer.
27. Linear expansion of a solid.
28. Maximum density of water.

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[209] Bulletin 47, 94-95.

29. Expansion of air at constant pressure.
30. Determination of melting points.
31. Determination of boiling points.
32. Determination of the dew point.
33. Laws of cooling.
34. Test of the "method of mixture."
35. Specific heat of a solid.
36. Latent heat of melting ice.
37. Latent heat of vaporization of water.

Light

38. Law of intensity of illumination.
39. Laws of reflection from a plane mirror.
40. Images in a plane mirror.
41. Images in a convex cylindrical mirror.
42. Images in a concave cylindrical mirror.
43. Index of refraction of glass.
44. Path of ray, and index of refraction, for a glass prism.
45. Index of refraction of water.
46. Focal length of a converging lens.
47. Conjugate foci of a converging lens.
48. Shape and size of real image formed by a lens.
49. Virtual image formed by a lens.

Electricity and Magnetism

50. Lines of force about a magnet.
51. Lines of force surrounding a conductor through which a current is passing.
52. Action of a current on a magnet.
53. Lines of force surrounding a coil of wire carrying a current.
54. Study of a single fluid cell.
55. Study of a two fluid cell.
56. Resistance, by substitution.
57. Resistance, by Wheatstone Bridge.
58. Resistance of conductors in parallel.
59. Study of electric bell and telegraph.
60. Study of induced currents.

Table 2: List of Experiments in Physics[210]

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[210] Bulletin 47, 94-95.

Zoology

Although zoology was not required for entrance to the University of Texas, the university Committee on Affiliation still recommended zoology as a secondary school offering. According to Thomas Harrison Montgomery, Jr., a U.T. Professor of Zoology, it provided college bound students with solid scientific work and, for students not pursing advanced academic work, the course would broaden their field of general knowledge. The university faculty suggested several teaching methods for zoology. For example, the first duty of the zoology teacher was to make the course interesting. Once students became interested, they would need little further help and encouragement. The use of the laboratory in zoology was indispensable. Textbooks, primarily used by the teacher, provided information of marginal importance after laboratory work. A minimum of five instructional hours per week with one or two hours for classroom work and the remainder dedicated to laboratory work, with the suggested course listed in Table 3.

1. Earthworm; external anatomy.
2. Idem. Anatomy of body wall, intestine, nervous system.
3. Idem. Anatomy of dissepiments, peritoneum, nephridia, blood vessels.
4. Idem. The functions of the main organs and the correlation of the nervous system.
5. Cricket or Cockroach; external form, mode of producing the music.
6. Idem. Anatomy of intestine and tracheae.
7. Idem. Anatomy of reproductive organs and nervous system.
8. Metamorphosis of cricket and butterfly.
9. The bee; polymorphism of the individuals, work of various individuals and structure of the mouthparts and of honey basket.
10. Idem. The building and stocking of the hive.
11. Protective colors and structures of the hive.
12. Mimicry (study of insects).

13. The struggle for existence as a factor in mimicry and protective coloration.
14. Plant lice; the alternation of generations.
15. Regeneration; experimental work on Planaria.
16. Hydra; general structure and appearance.
17. Idem. Asexual generation.
18. The egg and sexual generation.
19. Cleavage of frog.
20. Formation of the tadpole and metamorphosis into the frog.
21. General processes of development: cell division of the egg, arrangement into tissues, folding of tissues. Specialization of the parts.
22. Birds; structural adaptations to the mode of life, modification of the bill.
23. Idem: structural modification to the feet and legs.
24. Migration of birds, routes and extent of migration.
25. Idem: time of migration, some of its factors.
26. Birds: Architecture and care of the young.
27. Feathers, their structure, arrangement and use.
28. Differences in domestic races of pigeons or fowls due to human selection.
29. The principle of natural selection.
30. Some general principles of evolution.

Table 3: Suggested Course of Study for Zoology[211]

SECOND SET OF STANDARDS FOR AFFILIATION OF SCIENCE COURSES, 1908

Three years after the first set of curriculum standards, the University of Texas published a second set of guidelines. Bulletin No. 106, "High School Bulletin," dated April 1, 1908. These new guidelines were contained in the Bulletin of the University of Texas, No. 106, dated April 1, 1908 and described as "Suggested Courses of Study for High Schools."[212] These new standards, while similar to the 1905 standards, contained more details in the course outline, subject matter, equipment, and teacher qualifications.

[211] Bulletin 47, 103-104.

[212] Bulletin 106, 17.

Botany

The recommendations for botany begin with an opinion that every school supported by the state should offer instruction in botany because the state's resources are largely measured by the products of plant growth, cotton, cereals, lumber, fruit, grasses and garden products. Botanical investigations have created new varieties of cotton that mature earlier, or are immune from attacks of diseases or insects. New varieties of wheat have been created that are better suited to hot, dry climates, resist red rust better and provide a harder grain. Botany involved training the powers of observation, manipulation, and developing the ability to express judgments. Supplies for botany were abundant, conveniently at hand and imposed no large expense in setting up botany laboratories.

The actual course work contained three sections. The first part expressly stressed the study of living plants themselves and the life process: that life began with the seed in the highest plants, beginning the cycle of life. The cycle of life advanced from the seed stage, to the embryo and the germination stage, to the seedling stage, and finally to the mature plant that produces seed for the cycle to begin again. Gathering a typical collection of plants and following a key to establish the Latin name of the plant while amassing a vocabulary of meaningless names of parts was to be discarded as practically worthless for educational purposes. Following the first part, the second part would take up the study of the plant kingdom in which the most primitive plants would be studied first, advancing to the highest plant, following the order of evolution. The last and third part contained the practical application of the acquired knowledge of plant growth and structure. This part covered the adaptation of each plant to the physical environment. Factors considered were which climate and soils, together with the combination of light, temperature, moisture and soil texture influenced the structure and distribution of plants in the state. The plant geography of Texas provided practical information for each plant as well as consideration for specific regions combined with how associations of plants in these specific regions formed characteristic types of vegetation such as forest, prairie, or desert. From these studies came prominent species to be considered for studies of adaptations to their particular habitat.[213]

As before, and with all the sciences, classes were to be forty-five minutes in length, for thirty-six weeks. Laboratory periods should be double the length of the recitation period with three lab periods weekly and two recitation periods per week, allowing laboratory work to be over one half of the course work. The laboratory equipment suggested a moderate outlay of funds. Two estimates were provided, Estimate A required an expenditure of $530.00, while Estimate B only required an expenditure of $55.00. The main difference in cost from Estimate A to Estimate B, was in the expense of a special laboratory room equipped with laboratory tables, each accommodating four pupils and ten compound microscopes. Estimate B used the existing recitation room and desks with home-made dissecting microscopes. In conjunction with the classroom, a reference

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[213] Bulletin 106, 103-108.

library was suggested. Two lists were provided, an A list recommended for Estimate A labs and a B list for laboratories using the Estimate B list.[214]

Laboratory time was to be fully employed by every member of the class. Sloppy work was not to be tolerated. The student was required to keep a suitable notebook containing a record of his work. The notebook was intended for students to develop their discoveries, making the work their own, not just regurgitating textbook work. The content of this laboratory work was meant to study form and structure and demonstrate a plant's vital processes: respiration, growth, starch formation, absorption rate, effect of gravity and light. Some field demonstrations were suggested: one to demonstrate how the amount of sunlight affects plant growth; two, to demonstrate the effect of different soils on the same species of plants; three, to show the difference between cotton plant growth in plants grown from inferior seeds and plants from vigorous plant seeds; and fourth, to compare cultivated fields to non cultivated fields of cotton growth. These field problems were considered to be of vital concern to the farmer and to the State of Texas.[215]

This section of Bulletin, 106, also contains the first reference that plant biology, botany, and animal biology, zoology be combined into a new general course to a new course, called biology,.[216]

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[214] Bulletin 106, 108-112.

[215] Bulletin 106, 113-114.

[216] Bulletin 106, 104.

Chemistry

The section on chemistry, from Bulletin 106, states that if chemistry is properly taught it would have as much educational value as any other subject, but if badly taught it would be valueless. To insure that high schools would know exactly the expectations for a chemistry course, the university included a complete copy of the "Special Report of the Committee on Chemistry Presented to the Committee on College Entrance Requirements of the National Education Association." Bulletin 106 states that the "University of Texas desires to see this report in force at once."[217] The value and place of chemistry was obtained by the training of observation skills by the student and the first hand information which would be obtained about well known materials, the principles of their manufacture and their properties.

Observation skills were to be refined in laboratories. Without laboratory work, a course in chemistry would be worthless. The experiments had to be performed by each pupil individually. A notebook was to be kept by the student recording each observation and the interpretation of each observation. Simple quantitative experiments began the laboratory work; no less than six experiments, followed by exercises on the recognition of chemical substances with suitable dry and wet-dry experiments. Laboratory equipment suggested, for a chemistry course to be taught correctly, should contain desks with gas and water connections, bottle racks and well-ventilated hoods. Students would be supplied with their own set of apparatus. Every six students should have a balance with case and weights

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[217] Bulletin 106, 94.

included, plus barometers, thermometers, burettes-two for four pupils at a minimum, porcelain crucibles for each student and a bottle aspirator for each student.[218]

Classroom teachers were encouraged to use demonstrations, fully illustrated, if the apparatus was complicated, too expensive to be available to each student, or if the student would waste time attempting to complete the experiment. Theories and principles were to be presented inductively. Each teacher was strongly encouraged to read Hofmann's Lectures on Modern Chemistry. Teachers were expected to continuously supervise laboratory work, examine student notebooks, insure that students did not just merely complete each task mechanically by individually questioning each student, and examine quizzes from the entire class. In this manner, each student would realize the practical significance of each experiment. To further classroom study, a small library was recommended so that each student would not perceive the textbook as a complete treatise on the subject of chemistry.[219]

Subject matter for the class should include the chief physical and chemical characteristics and the preparation and recognition of the following elements and their main compounds: oxygen, hydrogen, carbon, nitrogen, chlorine, bromine, iodine, fluorine, sulphur, phosphorus, silicon, potassium, sodium, calcium, magnesium, zinc, copper, mercury, silver, aluminum, lead, tin, iron, manganese, and chromium. A more detailed study should be included of the following

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[218] Bulletin 106, 96-100.

[219] Bulletin 106, 97-98.

compounds: water, hydrochloric acid, carbon monoxide, carbon dioxide, nitric acid, ammonia, sulphur dioxide, sulphuric acid, hydrogen sulphide and sodium hydroxide. The elements of the atmosphere as they related to animal and vegetable life should be included, as well as flames, acids, bases, salts, oxidation and reduction, crystallization, manufacturing processes, and familiar substances such as baking powder, glass, steel, common alloys, porcelain and soap.

Also included in the descriptions for course work were, combining proportions by weight and volume, symbols and nomenclature, atomic theory, atomic weights and valency, natural grouping of the elements, solutions, ionization, mass action and equilibrium, strength of acids and bases, conservation and dissipation of energy, chemical energy, and electrolysis.[220]

Physics

Physics could be offered as fulfilling an entrance requirement of the University of Texas when this bulletin was published. The bulletin stated that while physics courses be affiliated at this time, it was deemed proper for the University to set forth some methods of instruction. The suggestions would not include any unusual or untried methods. The methods put forth would lead to the best mental discipline and encourage the development of the high school. Both lectures and recitations should be combined with frequent illustrations and laboratory exercises. Five periods of forty minutes each would be devoted to the course, with three periods for classroom instruction and the remaining two periods devoted to individual laboratory experiments. In addition, it was suggested that

[220] Bulletin 106, 98-99.

the laboratory periods be extended by two consecutive periods, requiring that a study hall be scheduled to accommodate the two consecutive periods once a week. Special emphasis should be given on the solution of numerical problems, with a homework assignment of four problems for each recitation period, with one that should be a review of previous work. Paper of uniform size was to be used to aid in the grading of the papers. It is interesting to note that this section contains the first mention of the use of the English language. Each student would be required to use proper English and express himself clearly and accurately. There was to be no excuse for science students to use bad grammar and poorly constructed sentences in any work done.[221] The teacher, to provide good instruction, required more work than in mathematics or the languages. The science teacher needed to spend time collecting materials, preparing experiments and keeping collections in order. Teacher certification is mentioned here also; the first time certification has been mentioned. Teachers with only the minimal instruction to acquire a state teacher's certificate, were not deemed qualified enough to warrant a position as a science teacher. These teachers were encouraged to attend the university for summer course work or high schools were encouraged to hire University graduates.[222]

Laboratory practice again was considered to be of utmost importance. A proper understanding of physics could not be acquired without individual laboratory practice; no amount of classroom work could compensate for the lack

[221] Bulletin 106, 76-78.

[222] Bulletin 106, 82-84.

of laboratory exercises. The real value of laboratory work was secured when the student performed each experiment himself and obtained and classified all data with little or no assistance. Each student was required to maintain a notebook that specifically contained precise statements of the problem being solved, the apparatuses used, any necessary formulas and computations used, and the observed results used to draw inferences. The laboratory exercises, in general, should compel close observations; the exercise should provide the basis for the development of a generalization, with the reasoning used in the observation and inferences simple enough for the student to make by himself with little or no assistance from the teacher. The equipment needed would include sufficient apparatuses so the class could work individually on the mandatory thirty-five experiments. However, experience showed that affiliated schools were able to complete forty-five experiments. Costs estimated that, for twelve students, $250.00 dollars be allocated with additional expenditures each year.[223]

THIRD SET OF STANDARDS FOR AFFILIATION OF SCIENCE COURSES, 1910-1913

The third series of bulletins was issued over several years. The first bulletin, No. 150, "Physics in the High School," was printed in July 1, 1901. The second bulletin, No.210, "Chemistry in High Schools," printed on December 8, 1911, and the third bulletin, No. 299, "Biology in the High School," was printed on October 15, 1913. These three bulletins continued the suggestions issued by

[223] Bulletin 106, 79-83.

the University of Texas for the state's high schools in preparation of their science courses for affiliation with the university.

Biology

A bulletin issued by the University of Texas, in 1913 contained the first standards for biology in the high school, which coincided with the first year biology, was listed as an affiliated subject. A general statement averred that a teacher of biology should consult the previous bulletins on botany and zoology. The two previous bulletins on botany and zoology had set forth the requirements for the selection of illustrative material, organization and presentation that the new biology bulletin would supplement.

The suggested plan preferred included one-half year devoted to botany and the other half of the year devoted to zoology. This plan was the preferred one, especially for the smaller high schools in the state. There was no advice given as to which course, botany or zoology, should be scheduled first, only that the two subjects could and should be made supplemental as a unified course. Many principles common to both plants and animals could be touched upon during the year without any duplication. It should be an easy step to connect the study of plants to the study of animals whether botany was taught first or if the schedule was reversed.[224]

The aim or purpose of the course included equipping the student with an insight into the fundamental laws of living things, their adaptation to the environment, the struggle for existence, the development of the individual,

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[224] Bulletin of the University of Texas 299 "Biology in the High School," (October 15, 1913): 3-4.

reproduction, and the conservation of movement. The student, by mastering the generalization of the science, would develop mental discipline. Technical details and the rote memorization of mere names should be eliminated with the emphasis placed on the mastery of principles. The student was expected to acquire an observant attitude of mind to increase his store of knowledge day to day. The use of plants and animals and their relation to the needs of man for food, clothing and shelter should be included. Finally, to influence the pupil's moral nature, he was to be taught the laws of nature with the effects of the struggle for existence and the benefits of mutual and social cooperation.[225]

The teacher, while preparing for the class, was expected to gather the illustrative material for the laboratory from the immediate environment. Beginning the studies with the most common plants such as the bean plant, and for animal study, insects, because of their wide distribution should receive a large share of class time. Of particular importance would be their variety of form, adaptation to the environment and their economic value. Live animals and plants should be studied in their natural environment, suggesting that field trips be scheduled as often as possible. Of course, dead animal and plant specimens were essential for the study of anatomy. The writers of this bulletin again stress that the use of elaborate keys for the identification of plants and animals should be dispensed with. The study of botany had not recovered from several decades before when the usual course consisted in the identification of parts and the name of the plant. A warning was included against selecting textbooks that had such

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[225] Bulletin 299, 4-5.

identification keys in the book. While a good general biology book was not available for high school biology, books for the study of zoology, botany, and general studies were included. These books were usually for a full-year course. While the high school would only teach each subject for one-half of the year, it was felt that it was better to use a text which contained more material than needed, rather one that did not contain enough material. In addition, various publications from the Biological Survey, Forestry and Plant Industry, and the appropriate bulletins from the Department of Agriculture were recommended for study.[226]

Chemistry

This bulletin continues the instructions for teaching chemistry in the high school classroom. This bulletin furthers the increasing complexity of each succeeding bulletin. This bulletin, number 210 includes more extensive and detailed instructions than either of the other two bulletins. The teacher qualifications were addressed in the beginning.

The teacher is the first and most important component of the classroom. They were to be science teachers, by both inclination and training. Sound training in chemistry from a university where the subject was extensively taught rather than where only introductory work was done was preferred. The teacher's education was to include no less than two thorough courses in a first class university plus additional training, at least one course, in physics, botany or zoology. These course requirements were considered a bare minimum.

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[226] Bulletin 299, 5-8.

The operation of the laboratory received extensive and detailed instructions beginning with the ordering of laboratory equipment and supplies no later than early June. If materials were ordered by this date, the school would be able to secure several bid quotations for duty-free importation and delivery. During this period, nearly all laboratory apparatus and supplies were shipped from Europe. A list of the larger chemical dealers was included.

Proper ventilation for the classroom received special attention; all fumes should be removed rapidly and not blown into other parts of the building. Preference should be given to using a classroom, on the outer wall, with windows on two sides so the fumes could easily be transferred to the outside. For noxious gas fumes, a draft hood was recommended. A smaller hood was preferred, with the fume stack as vertical as possible and the hood itself as small as possible to increase the air velocity moving through. The fume stack should not be less than one-third of the cross section of the hood proper, a large gas burner should be provided at the base of the stack to aid in the flow of gases during quiet weather, and a cap, if used at all, should be placed very high above the edge of the stack.[227]

Student laboratory desks were to be placed to allow enough room for the students and teacher to pass each other and easily obtain supplies. The distance between desks should be four feet, six inches with the distance between the desk and the wall no less than six feet. A platform with a table for demonstrations and a blackboard should be situated so the teacher could perform special demonstrations or special instructions during laboratory time. The desks should

[227] Bulletin of the University of Texas 210 " Chemistry in High Schools," (December 8, 1911): 10-13.

be placed in conjunction with the gas, water, and sewer plumbing. It was desirable to have the pluming run underneath the ceiling of the room below the laboratory for easy access for repairs. No high shelves or other structures were to be placed on student desks that would hinder the teacher's view of any desk. The desks were to contain individual lockers under each desk, preferably only two lockers, with the top table space forty-two inches in width, twenty-four inches in depth and at least thirty-six inches in height. Each student was to have access to two gas cocks with a water faucet and sink between the two students. The gas cocks should be chosen carefully to insure the proper fit between the gas cock and the Bunsen burner rubber tubing. A warning was included to prevent the use of the gas cocks normally used in dwellings, as they were too large for the Bunsen burner tubing. The sinks were to be of porcelain, hemispherical, and fourteen inches in diameter. Also included were several suggested manufacturers of the desks, with the best design from the L.B. Altaffer Co. that produced the Altaffer Individual Desk.[228]

A broad list of laboratory apparatus and chemical supplies was included. The general laboratory supplies for a class of twelve students were to include one blast lamp with foot bellows for glass blowing and construction of glass apparatuses and six sets of eight desk regent bottles with labels in the glass for concentrated and dilute sulphuric acid, concentrated and dilute hydrochloric acid, concentrated and dilute nitric acid, ammonium hydroxide and sodium hydroxide. In addition, fifty to seventy-five bottles with ground glass stoppers, for general

[228] Bulletin 210, 13-19.

use and balances for ordinary weighing, capacity 1000 grams for every ten students were included. A water still should be installed for distilling water for experiments. For quantitative experiments there was to be a balance, with a glass case that was sensitive to a milligram. The cost for the equipment was estimated at $400.00 if the furniture could be made cheaply as possible, including desks and lockers for twelve students, side shelves, one draft hood and chemical supplies. An annual maintenance fee for expendable supplies and replacement of broken equipment was suggested at $8.00 to $10.00 per student. It was also noted that the student might be responsible for $2.50 to $5.00 of the expense. In many Texas high schools the school board appropriated as much as $10.00 per student annually.[229]

The design of the chemistry laboratory was primarily for the student who would not continue chemistry studies beyond the high school. It was believed that this course would also properly prepare the college bound student if the instructions in this bulletin were followed.

This bulletin states that the order of the courses of physics and chemistry was best left to the high school. Without actually making a recommendation, a comment was made that the progress of the chemistry class would be slower if the class was given during the earlier grades instead of in the last year.

As with the other sciences, chemistry required three recitation periods each week, with two double periods for laboratory each week. The double period was to be uninterrupted. In addition to the normal off period for the teacher, the

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[229] Bulletin 210, 25-36.

chemistry teacher needed another period each day for preparation of the laboratory supplies and equipment.[230]

Students were also required to maintain notebooks with correct spelling and composition. The pre-prepared worksheet with blanks to be filled in writing up experiments should be avoided at all costs. A few general directions were needed, but no standard formula or standard form should be encouraged. The laboratory notebook was to be just that, a book of notes, not a re-written book of essays.

There were a few requirements for each laboratory experiment, however. A suitable heading was required to force the students to realize the purpose of the laboratory experiment. Following the heading would be a brief definite statement of what was actually noted or observed followed by the equations of the reactions in the experiment.[231]

The course presentation should avoid beginning with definitions, such as elements, compounds, chemistry, atoms or molecules. The teacher should prepare and demonstrate several elements, oxygen, hydrogen and chlorine and simply tell the students, "these are elements." Through continued use of demonstrations, the student would be able to form a definite idea of the meanings of elements, compounds and chemical actions. This teaching method would allow the students to construct their own definitions. Additionally, it was recommended that the use of chemical symbols and formulas be introduced as early and as extensively as

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[230] Bulletin 210, 38-40.

[231] Bulletin 210, 42-43.

possible. The course would be primarily a presentation of experimental facts and introduce theory to as slight an extent as possible. The first presentations would consist of only simple types of reactions, and then after the simple reactions had been understood, proceed to reactions that were more complex. One other recommendation concerned practical application. The major part of the direct value of the course to the high school student would be obtained by the use of accurate information on practical subjects.[232]

These suggestions were extensive in their detail, more so than any other bulletins on science courses. It is interesting that following these suggestions a short paragraph was included concerning affiliation with the University of Texas. This paragraph began with the notion that these suggestions need not be followed to secure affiliation in chemistry at the University of Texas. They were offered to teachers as aids in shaping their courses in chemistry and "whether or not these suggestions are followed has nothing to do with securing affiliation."[233] The paragraph continues with the suggestion that the university aims to be exceedingly liberal and broad-minded in its requirements for affiliation, and then listed four requirements for affiliation. The first was a properly prepared teacher; the second was a proper class time allowance of three recitation periods of forty-five minutes each, three times a week followed by two ninety-minute laboratory periods per week for one school year. Third, was a fairly well-equipped laboratory for individual student work; and some evidence that the teacher

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[232] Bulletin 210, 42-56.

[233] Bulletin 210, 60.

prepares a well planned and well conducted course, obtained by a visit from the representative from the university combined with an examination of the notebooks of the students.[234]

Physics

This bulletin continues the suggestions on the teaching of physics from the previous bulletins. Since physics could be offered to fulfill an entrance requirement of the University of Texas, it was desirable to teach the course using a general understanding of the methods on instruction that actual experiences had shown to be essential, that the course in physics was seen as a factor in the education of all high school pupils. If these methods were used, it naturally would follow that affiliation would be granted to the high school. Some faculty members considered that these methods had become too theoretical, having but slight connection with the practical application of physical principles, and therefore devoid of interest to the students. They felt that too much attention had been given to methods of exact measurement without consideration for the meaning or value of the measurement and that the use of technical terms had taken the place of plain, common everyday English. These criticisms were addressed, and while some revision was needed, the character of the textbooks available for both classroom and laboratory, it was not deemed wise to make any extensive changes in the earlier recommendations since the teacher must depend upon the textbooks.[235]

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[234] Bulletin 210 60.

[235] Bulletin of the University of Texas 150 “Physics in the High Schools,” (July 1, 1910): 3.

One change that was made concerned the periods that were devoted to laboratory work. Previously, it had been recommended that two periods per week be devoted to laboratory work. With the bulletin, that requirement was changed to one double period per week. It was noted that this recommendation differed from the previous bulletins because it was evident that too much emphasis had been placed upon laboratory practice at the expense of classroom exercises. Since each period lasted forty-five minutes, this change allowed four recitation periods per week instead of the previous three periods per week. Laboratory work was originally recommended for two forty-five minute periods per week, and this change would have laboratory work only one day per week for a double period. In actuality this change added one forty-five minute period to each week. Laboratory work would be done in a single day, leaving four days for classroom instruction, so physics was allotted six forty-five minute periods per week. The recitation periods should include frequent illustrations to introduce new ideas, and simple apparatus, which could be homemade, was suitable to stir the student's interest.[236]

Textbooks were problematic because no one textbook was ideal for a one-year course in physics. The textbooks attempted to teach too much in a given time. It was stated that physics could not be mastered in one year any more than could Latin or History. In addition, numerical problems were to be used: at least four problems each recitation period with one of the problems from the text from

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[236] Bulletin 150, 4-5.

previous days. In every case, in both written work and oral recitation, the student was expected to use good English, speaking clearly and accurately.[237]

Each student, obtaining and classifying all the data with the least possible assistance, should perform the laboratory exercises. These exercises should compel close observation developing some skill and self-reliance. The exercise should contain the basis for the development of a generalization of a principle. In reaching the conclusion, the student's reasoning must be simple and direct and, finally, each exercise should be quantitative in nature with a reasonable degree of accuracy. These observations would be written in a notebook. This laboratory notebook should contain the problem to be solved, the apparatus used, any necessary formulas and computations and the observed results with any inferences the pupil could be expected to draw. The laboratory work was to be individual work with sufficient apparatus for each student.[238]

Two rooms were suggested, one for classroom purposes and one for laboratory use. The classroom should have contained a large desk with a sink for experiments on the properties of liquids and with gas and electric connections for demonstrations. The second room should have been set aside for laboratory work and furnished with the necessary tables, stools, cases for apparatus, and sinks. In addition, it was mentioned that it was a serious blunder to attempt to combine either the classrooms or laboratories for chemistry and physics, as this arrangement would end up destroying the physical apparatus. In addition, it was

[237] Bulletin 150, 3-6.

[238] Bulletin 150 7-9.

suggested that for small classes a large room, if available, could be used as both classroom and laboratory. Expenditures for the establishment of the first course would be small, but steady increases each year would be required to maintain and strengthen the physics course.[239]

Several high schools had acquired affiliation in physics with the university, but many more desired affiliation. In order to secure affiliation, suggestions for the high schools follow. There should be five periods of at least forty minutes each per week for the entire school year, with one period devoted to laboratory work. A high-grade textbook was desired with numerical problems assigned for homework each day. Individual laboratory practice, with adequate apparatus, should be provided for a minimum of thirty experiments completed from a list of experiments provided each school year.[240]

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[239] Bulletin 150 11.

[240] Bulletin 150 14.

Chapter Seven: Affiliated Science Courses

AFFILIATED SCIENCE COURSES WITH THE UNIVERSITY OF TEXAS

A new hands-on pedagogy that enhanced the teaching of science began to take shape in the early years of the twentieth century. This pedagogy combined the hands-on pedagogy of Pestalozzi with inductive methods, and problem solving within the context of familiar experience. Further, it emphasized the authentic tasks related to work in the sciences. The use of apparatuses, including models, also helped students transfer abstract knowledge into the familiar world of the visual and tactile.[241] Newly developed technology apparatuses enabled teachers to demonstrate visually abstract natural forces, thereby initiating a new pedagogy of visual demonstration.[242] This new pedagogy shaped school practices and pedagogical thinking. The new methods required new apparatuses and cabinets to display models such as stones, skeletons, levers, and electrical apparatus. Illustration 1 displays an example of cabinets and apparatus in a Brownsville, Texas high school science classroom from the year 1915.

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[241] Edward Stevens Jr., The Grammar of the Machine (New Haven: Yale University Press, 1995): 73-75.

[242] Ian Grosvenor, Silences & Images (New York, Lang Publishing, 1999): 71.

Illustration 1: Brownsville High School Science Room, 1915.[243]

With the beginning of standards established by the University of Texas Committee on Affiliation, the natural sciences began to materialize as appropriate subjects for Texas high schools.

SCIENCE CURRICULA AND AFFILIATED HIGH SCHOOLS

In the new secondary schools of Texas in the late nineteenth century, the curriculum taught was mainly tied to traditional subjects, but there were no standards published for these schools. When the University of Texas initiated a

[243] Robert Runyon Photograph Collection, [image number 04076], courtesy of The Center for American History, The University of Texas at Austin.

program of affiliation for the state's high schools, the university was destined to exert a tremendous influence on these schools. For the first ten years, the affiliation program received little attention or effort. The university operated during the first years of its existence with no president. A faculty committee saw to the daily affairs of the university. A Chairman of the Faculty was elected who was required not only to carry a full teaching load but also to solve all internal problems of the university. The first elected Chairman of the Faculty, was Dr. John H. Mallet, in 1883-1884, followed the next year by Dr. Leslie Waggener, professor of English and History. In the year 1895, the Board of Regents decided that it was imperative that a president be appointed. The honor of the first presidency went to Dr. Leslie Waggener.[244] A picture of the first faculty members is included in following illustration.

[244] Carl J. Eckhardt, In The Beginning of the University of Texas (1979): 38-41.

Illustration 2: First Faculty Members, University of Texas[245]

John W. Mallet is the first professor seated on the left and Leslie Waggener is the first professor standing on the left.

The same year that the university acquired its first president, a renewed effort began with the school affiliation program. During the year 1895-1896, the university again turned its attention to the high schools. The subjects for affiliation were named, schools were visited and some attempt was given to shape and form the curriculum.[246] With the prize of affiliation available to schools, local pride alone was sufficient to encourage the schools to attempt affiliation. A letter to the superintendent of McKinney High School states, "It seems somewhat

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245 "The University's First Faculty, 1883-1884," Foundation and Growth: Images of the University's Early Years (Center for American History, The University of Texas at Austin, CN0962).

246 Bulletin 106: 5-7.

strange that the desirability of affiliating with the University has not been recognized by this community.[247] Another letter asks that the "Honorandi et Reverendi Texiause Uinversitatis would not cast my little school into the outer darkness of educational inefficiency."[248] Before, only tradition had been the curriculum guidelines, now standards in the form of affiliation offered guidance. Where administrators previously guessed in formulating their curriculum, they now received expert advice and constructive criticism from the university visitors. The result was the first serious attempt at curriculum building and standardization in Texas.

It will be recalled that physics, under the name of natural philosophy, had been prominent in the academies and appeared in the curricula of some early high schools, with botany and chemistry. Poor teaching and lack of adequate laboratory facilities rendered these sciences to be of little value. In addition, the University of Texas provided no guidance for the sciences before 1901-1902. Beginning in 1901-1902, the University of Texas began to affiliate schools in science courses. In 1905, the University issued the first bulletin, number 47, "Questions Concerning Courses of Study and Methods of Teaching in High Schools," followed by two more in 1908 and 1910. These bulletins described ways of improving the teaching of science, laboratory work, and student

[247] "Letter, Prather to Hill, April 24, 1905," (McKinney Affiliated Schools Records, Texas Affiliated Papers, Box 4P307 UT Affiliated Schools Records, The Eugene C. Baker Texas History, Center for American History).

[248] "Letter Jones to Henderson, April 28, 1909," (Thomas Arnold High School, Affiliated Schools Records, Texas Affiliated Papers, Box 4P288 UT Affiliated Schools Records, The Eugene C. Baker Texas History, Center for American History).

notebooks, and provided recommendations for physical organization of the course. One such example states "that the laboratory is an absolutely necessary adjunct to the proper study of science."[249] These standards from the bulletins previously described can be compared to yield a progression of change over the years for the science standards. To determine the development of the sciences in Texas high schools the affiliation records, the University Bulletins and the catalogues of the University of Texas and archived records of the Committee of Affiliated Schools are used. It is not possible to determine when the first science course was taught in Texas, but previous examples date back to 1839, long before the University of Texas started. The affiliation records do record that several subjects, English, mathematics, history and Latin, achieved affiliation first, beginning in 1885-1886, before any science courses became affiliated. The high schools during the late nineteenth century were still considered "auxiliary" to the state university. The same section also uses the term affiliation, so it seems the two terms were considered interchangeable.[250] The program of affiliation affected high schools until, in 1900, it was stated that the university was now the head of the "great public school system of Texas." Graduates of the best high schools were admitted to the university's classes without entrance examinations.[251] The sciences continued to gain favor as high school subjects. W.S. Sutton, in an

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[249] Bulletin 47, 6.

[250] E.C. Branson, "The State University and the Affiliated Schools," The School Forum (June, 1894): 201.

[251] Editorial, "Ten Years of Progress in the University of Texas," Texas School Journal (February, 1900): 10.

article, declared that the natural sciences had an unquestionable place in the high school curriculum, that Texas and other Southern schools especially needed instruction in the sciences that pertained to nature, and that while the Southern schools had been studying politics, ancient languages, poetry and philosophy, the Eastern and Northern high schools had been studying physics, chemistry, botany and zoology and had in the process supplied all the experts in all technological lines. Texas needed to make provision for the sciences, provide laboratory equipment and after sufficient instruction that would guarantee the youth of Texas the same opportunities as other students in the East and North.[252]

During the movement in the state for the sciences to be added to the curriculum, teachers were poorly prepared for the teaching of science. Yet, teachers remained willing and anxious to meet the university's requirements in the subjects in which affiliation was offered.[253] In yet another letter, Henderson states that science teachers need assistance and the greatest assistance the University of Texas might provide would be to supply carefully prepared statements concerning the selection of suitable material and the proper equipment for laboratories.[254] The University of Texas and W.S. Sutton, as the Chairman of Affiliated Schools, responded with the three series of bulletins, from 1905 to 1913, reflecting the several areas of concern for improvement, teacher education,

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[252] William Seneca Sutton, "The High School Course of Study-Its Aim and Contents," Texas School Magazine (January, 1900): 6-7.

[253] Letter, Henderson to Harper, February 8, 1908 (Center for American History, Affiliated School Records, Box 4P465).

[254] Letter, Henderson to Houston, March 21, 1908 Center for American History, Affiliated School Records, Box 4P465).

textbooks, laboratory work with student notebooks, and time allotted per week during the school year.

TEACHER QUALIFICATIONS

Teacher preparation begins with the number of teachers employed for the high school. In the Affiliated Schools Committee minutes in 1901, a motion was carried that the committee could not recommend any school that did "not it good faith employ at least two teachers."[255] This regulation had been enacted several years before, and now the regulation would be inserted into the university's catalogue. This regulation in the May 6, 1901, minutes indicated that the committee took regulations seriously. During this meeting, Brackett High School was notified that unless by October 1, 1901, the school employed two teachers, affiliation would be withdrawn. Affiliation for Latin was withdrawn at the same time.[256] Teacher preparation continued as a theme in all three series of bulletins.

The 1905 bulletin stressed that the teacher needed several university science courses for any chance of success. One course of physics, one year of general chemistry, one-half year of qualitative analysis, one-half year of quantitative analysis, one-half year of theoretical chemistry, and one-half year of organic chemistry, combined with some knowledge of the history of science was recommended for the training of high school teachers. College training for teachers became a very important issue in later bulletins and letters. A summary of a school visit by J.L. Henderson, Visitor of Schools, to San Marcos High

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[255] University of Texas Minutes, Affiliated Schools Committee (February 4, 1901).

[256] University of Texas Minutes, Affiliated Schools Committee (May 6, 1901).

School stated that more college-trained teachers were needed at the high school.[257] Two more letters continue to express the need for college training, the first, a letter to the superintendent of Lone Oak School noting that the superintendent's assistant was not college trained.[258] The second letter stated the need for more scholarship in the teaching force.[259] This scholarship took the form of teacher certification credentials. During this period, the state of Texas authorized teacher certifications to be issued as temporary and permanent certificates. Both types were divided into either a first or second grade certificate. The temporary certificate was valid for four years, while the permanent certificate was just that: permanent for life. A prospective teacher acquired this certificate by applying to the county board of examiners who examined the applicant for the certificate requested. A second grade certificate applicant was tested in the following areas: spelling, reading, writing, arithmetic, English grammar, geography, Texas history, elementary physiology and hygiene, with special reference to narcotics, school management and methods of teaching, United States History, and elementary agriculture. An applicant for the first class certificate was tested for, in addition to the second-class material: English composition, civil

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[257] Report by J.L. Henderson, January 21, 1909 (Center for American History, Affiliated School Records, Box 4P314).

[258] Letter, Henderson to McElhannon, August 21, 1909 (Center for American History, Affiliated School Records, Box 4P306).

[259] Report of Visit, Fletcher, April 22, 1912 (Center for American History, Affiliated School Records, Box 4P311).

government, algebra, physical geography, elements of geometry, and general history.[260]

Another bulletin of the University of Texas, Number 50, firmly established the role that the university should take to foster the education of teachers. Universities should emphasize that the development of education leadership was a critical factor of state and social institutions. The leadership of the university provided by the printed page promoted professional growth of teachers. The summer session conducted by the university was also a powerful influence. The university extension, another agency, lent itself easily and effectively to education improvement. University-trained men with breadth, depth, and rigor should conduct the education courses at the university. The courses at the university should include courses in school management, principles of teaching, physical education, psychology applied to education, child study, the history and the philosophy of education, school supervision, as well as special professional courses relating to the teaching of English, history, mathematics, the ancient and modern languages, the natural sciences, including manual training and domestic economy.

In addition to the course work, the first reference to student teaching as we know it today was made. A provision was included for the students to receive systematic training in observation and practice so that they might have many opportunities to enrich their newly learned theory by practice under skilled

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[260] Bulletin State Department of Education, Austin, Texas Number 43 (June, 1915) "The Certification of Teachers in Texas," 4-5.

supervision, thus gaining actual and practical experience in teaching.[261] The university departments of education provided a number of scholarships to young men and women who expected to make teaching their professions. The university, because of the importance of teaching, was to establish and maintain a department of education while coordinating with the other departments at the university. The material welfare of the state depended as much upon the work of the teacher as of the lawyer, physician or engineer.[262]

As early as 1581, Richard Mulcaster in his "Positions" suggested this: "Why should not teachers be well provided for, to continue their whole life in the schools, as *Divines, Lawyers, Physicians* do in their several professions?"[263] Mulcaster continues listing four supporting reasons: that education was the means to make a society, that large numbers of students desired to be teachers, that the necessities of the profession could not be spared, and lastly, that the studies that were required by the greatest of professions, in language, in judgment and for in skill depended on training in of all points of learning.[264]

While certification for teachers had been established in Texas since 1884, the majority of teachers only held secondary certificates until 1915 when first class certificate holders surpassed secondary certificate holders. In 1902, when the state's schools totaled 739,573 students, with 16,170 teachers, fifty-three per cent

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261 Bulletin of the University of Texas Number 50 (January 15, 1905) " What Should Be Done by Universities to Foster the Professional Education of Teachers?" 7-9.

262 Bulletin 50, 10-11.

263 Richard Mulcaster, Positions (London, Longman, Green and Company, 1888): 248-249.

264 Mulcaster, 10.

were taught by teachers with secondary certificates and thirty-three per cent were taught by teachers with first grade certificates. Clearly, the importance of teacher certification was not lost on the Committee of Affiliated Schools.[265] In fact, several letters were written to the Committee, one from the school in Petrolia, Texas, asking if the university would grant affiliation in the subjects taught by a teacher who held a first grade certificate.[266] A response from Henderson, the Visitor of Schools, indicated that while the university had not published any rules prohibited affiliation by teachers holding first grade certificates, the university found that unless the teacher had some additional college training, he or she failed to meet the standards for affiliation. The letter goes on to state that a teacher that held a first grade certificate could not be admitted to the University of Texas solely on that certificate.[267] Another reference to teachers with first grade certificates occurred in a letter to the school in Round Rock, Texas. Henderson states that he was concerned that the Round Rock School could not obtain college trained teachers for sixty and seventy-five dollars a month. As a result, the school employed teachers with first grade certificates, which hindered approval for affiliation.[268]

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[265] Bulletin of the Department of Education, State of Texas, Number 133 (August, 1921), "Historical and Statistical Data as to Education in Texas, 198-199.

[266] Letter, McConnell to Visitor of Schools, April 16, 1914 (Center for American History, Affiliated School Records, Box 4P311).

[267] Letter, Visitor of Schools to McConnell, April 20, 1914 (Center for American History, Affiliated School Records, Box 4P311).

[268] Letter, Henderson to Ferguson, December 14,1914 (Center for American History, Affiliated School Records, Box 4P313).

The first importance for affiliation was the qualifications of the teacher, next was adequate laboratory equipment and last was a modern textbook.[269] Teacher qualifications were very important to the Committee of Affiliated Schools. Even if a high school had acquired affiliation for a subject, should new teachers be employed in that subject, new student papers and notebooks would be requested for these subjects. Following a successful judgment by the university faculty that the papers still met affiliation requirements, the high school would retain the affiliation for that subject.[270]

The bulletin, Number 106 in 1908 added that teachers should be prepared to use lectures, recitations and fully illustrated demonstrations. These demonstrations should not replace student laboratory experiments but should be employed only where the apparatus was complicated and could not be supplied to each pupil.[271] While lectures were contained in the recommendations, student laboratory experiments remained as the main class focus. A letter report of a visit by a faculty member to Lubbock High School stated that one particular instructor was over fond of the lecture method.[272] Teachers needed time to prepare for these lectures, collect materials for laboratory use and maintain the collections of the department, so this bulletin recommended that the additional time needed for

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[269] Bulletin 47, 77.

[270] University of Texas Minutes, Affiliated Schools Committee (June 3, 1901).

[271] Bulletin 106, 97.

[272] Report, Visit to Lubbock High School by R.A. Law, April, 1914 (Center for American History Affiliated School Records, Box 4P306).

science teachers should be allowed in school programs and salaries.[273] As another example, the Visitor of Schools, after a visit to Houston Heights School, stated, "the science instructor has too many classes other that science. She teaches four mathematics classes in the afternoon. This does not give her any time to prepare her laboratory work. She should be relieved of the last class just before noon if possible."[274] This reinforced the requirement for affiliation that science teacher be allowed extra time for preparation for their science classes.

LABORATORY REQUIREMENTS

Science teaching in the secondary schools was, for the most part, a matter of textbook pedagogy until the post Civil War period. The larger colleges and wealthier academies had some demonstration apparatus, but in the early days such equipment was the exception rather that the rule in secondary schools. Only two out of more than fifty schools were listed with a good chemical and philosophical apparatus.

Massachusetts, in 1857, continued the growing interest in science teaching by passing a law that required the teaching of natural philosophy, chemistry, and botany in high schools in towns with populations of 4,000 or more.[275] In Boston, the new high school, English High School when constructed contained a chemistry laboratory with a lecture room with rising tiers of benches and a lecture

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[273] Bulletin 106, 83-84.

[274] Letter, Visitor of Schools to Houston Heights High School, 1914 (Center for American History Affiliated School Records, Box 4P303).

[275] Rosen, 194-196.

desk with apparatus for demonstrations. The laboratories were located on the second floor, and had student desks, gas and water piping, shelves for reagent bottles and drawers to furnish storage for 176 sets of apparatus. In each laboratory room were two small rooms for storage: one for storage of a balance and apparatus and the other a storage room for chemicals.[276] The laboratory method of teaching sciences had begun.

Between 1887 and 1900, educators promoted the laboratory method of teaching. The president of Brown University in 1892 hailed the new methods of laboratory instruction, demonstrations, notebooks, and field trips and prepared specimens, to replace the textbook. The same year, the Association of Colleges in New England proposed that physics be introduced into the late years of the high school program as a substantial subject to be taught by the experimental or laboratory method, including exact weighing and measuring by the pupils themselves. The laboratory had won its place in the schools.[277] The school that was not well equipped with laboratories and apparatus was not looked upon as progressive.[278] Laboratories achieved a place in the schools because of the growing feeling that the scientific curriculum was more important for the demands of current society than the older classical curriculum, the increasing emphasis on empirical laboratory work in the universities and colleges, the

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[276] John D. Philbrick, "Boston Latin and English High Schools, Plans and Description of New Building," American Journal of Education Volume XXXI (1881): 417-419.

[277] Rosen, 202.

[278] L.L. Conant, "The Teaching of Mathematics," School Review Volume I Number 4 (April, 1893): 211.

influence of college admission requirements, and the popularizing of progressive ideas.[279]

The new entrance requirements at the University of Texas were a concern for the Committee of School Affiliation. During a meeting of the Committee of School Affiliation on November 20, 1900, Chairman Sutton suggested that the Chairman of the Committee on Entrance Examinations be asked the advisability of deferring the enforcement of the new entrance requirements, in science and modern languages until September 1902. However, with the stipulation that any high school now prepared for affiliation in these subjects be affiliated at once.[280] The requirements for affiliation contain several references for laboratory work. These requirements were delineated in the three series of bulletins, Number 47, Number 106, Number 150, Number 210 and Number 299.

The University of Texas, acting on the new national focus on science laboratories for students insisted that laboratory work was indispensable, that each individual conduct his own laboratory experiments recording close observations, formulate a basis of a generalization, reach conclusions with little assistance from the teacher and record these experiments in a student notebook.[281] These requirements were consistent throughout all the bulletins on the laboratory work and student notebooks. Notebooks should contain concise statements of the problem to be solved, apparatus used with drawings, any necessary formulas with

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[279] Rosen, 24.

[280] University of Texas Minutes Affiliated School Committee (November 20, 1900).

[281] Bulletin 47, 77-115.

computations, and the observed results combined with the inferences made by the student.[282] The notebooks were only a part of the affiliation process.

A high school requested affiliation and after an application was completed which contained the required methods, time of recitations, class meetings per week, and textbooks used, and the general work looked satisfactory, a member of the Committee of Affiliated Schools scheduled a visit. Such was the occasion that created a report of a visit to Plano High School in 1905. In the report from the visitor to the Superintendent, it was the opinion of the Inspector that Plano High School needed attention. The school was not up to standards, but the standards could be met with a little direction. The sciences had no equipment for laboratory work, but the school would provide the needed equipment soon.[283] Again, in a letter to the university, the superintendent states that the school has purchased equipment for the physics laboratory and desires affiliation in science. The superintendent closes with the statement that "we are anxious to have our school measure up to whatever you may demand."[284] The following week another letter was sent to the president of the State University explaining that Plano High School was expecting a visitor from the university but that he failed to appear. The Plano school had gone to considerable expense in purchasing a laboratory and had kept a record of experiments performed by each student. The Plano

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282 Bulletin 106, 81.

283 Letter, Hopkins to Johnson, April 24, 1905 (Center for American History Affiliated School Records, Box 4P311).

284 Letter, Walker to President State University, April 7, 1908 (Center for American History Affiliated School Records, Box 4P311).

school still was very much interested in the subject of affiliation for science.[285] The visitor from the university, C.D. Rice did visit Plano High School on May 8, 1908. In his report, Rice stated that the city of Plano had community pride the high school. The visitor also found good work in physics. The texts recommended by the School of Physics at the university were being used, and more than the thirty-five required experiments were being done. In addition, each student had been required to work out several hundred problems that illustrated the principles of physics in the notebooks with drawings and diagrams. The letter ended with a recommendation for affiliation of Plano High School in physics.[286] Plano High School did receive affiliation in physics and was listed in the 1908-1909 Catalogue of the University of Texas.[287]

The reports of the visitor to the high schools from the University of Texas continually stress the significance of the quality and quantity of laboratory equipment for affiliation. Paris, Texas High School received a letter dated November 3, 1903, that the school only lacks student individual laboratory work and affiliation could be granted in both chemistry and physics.[288]Luling High School in 1909 received a report of a visit from the university that the lack of apparatus is noticeable in physics with very little apparatus available, and what is

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[285] Letter, Walker to President of State University, May 1, 1908 (Center for American History Affiliated School Records, Box 4P311).

[286] Letter, Rice to Walker, May 8,1908 (Center for American History Affiliated School Records, Box 4P311).

[287] Bulletin of The University of Texas, Catalogue 1908-1909 (February 1, 1909): 462.

[288] Letter, Chairman Affiliated Schools to Wooten, November 3, 1903 (Center for American History Affiliated School Records, Box 4P310).

available is old and of no service. The visitor, while visiting classes, noted a rather mechanically recited book lesson in physics; neither the teacher nor any student advanced any critical thinking questions. The visitor finally stated that in his opinion affiliation should be withdrawn from this school until better equipment and a trained teacher could be provided.[289]

Affiliation was a prize to be achieved, but this example notes that unless the conditions for affiliation continued, affiliation could and would be withdrawn. Pilot Point High School in 1914 received a report of a visit by the W.S. Taylor, Visitor of Schools from the University of Texas. The report stated that the science department was poor equipped and poorly provided for. Physics had but very meager apparatus, chemistry had practically no equipment except for old and useless chemicals and botany being even more poorly equipped with only one compound microscope. The letter continued with some specific recommendations that the botany laboratory be equipped with tables, chairs, dissecting sets, dissecting microscopes and necessary glassware. The chemistry laboratory was to be equipped as soon as finances could be secured. Two double periods were to be allocated for laboratory work for each science.[290] The Pilot Point High School still did not have adequate laboratory equipment, in 1916, but the school had $200.00 immediately available for purchase of equipment for the chemistry course. A laboratory table sitting twenty students would be constructed and ready

[289] Letter, Payne to Luling School, March 30, 1909 (Center for American History Affiliated School Records, Box 4P306).

[290] Letter, Taylor to Willis, October 20, 1914 (Center for American History Affiliated School Records, Box 4P312).

for use when the newly purchased apparatus would arrive. The equipment purchased was compiled from university bulletins with the intent of meeting affiliation requirements. Papers and notebooks were to be submitted in all the science work offered. The submission of notebooks to be graded only occurred when the work at the school merited the submission for consideration for affiliation.[291]

Not only were the schools to provide required laboratory equipment, but the schools were also expected to maintain the apparatus. A visit to Plainview High School found the building in very good shape, with clean floors and the rooms were in very good condition. However, the laboratory apparatus was not properly protected and cabinets should be made available for the storage of the apparatus.[292] Lubbock High School also possessed some good apparatus for physics, but this school had no suitable laboratory tables for student work. Although this was only a suggestion, it did not prohibit the school's affiliation in physics to continue.[293] On a subsequent visit to Lubbock High School, science instruction was found in a miserable condition. The course and the laboratory work were not strong. No one particular reason was identified for the poor showing. The laboratory equipment was adequate, the class was small and time was allocated for the work. Nevertheless, the work done by the students was poor

[291] Letter, Phillips to Pilot Point School, October 26, 1916 (Center for American History Affiliated School Records, Box 4P312).

[292] Letter, Henderson to Plainview School, April 17, 1911 (Center for American History Affiliated School Records, Box 4P311).

[293] Letter, Henderson to Lubbock School, March 24, 1913 (Center for American History Affiliated School Records, Box 4P306).

and affiliation was suggested to be withdrawn.[294] A visit to Orange High School merited mention that the school was not doing the character of work that a school of the size of Orange should be doing. The building was dilapidated and never well planned. The sciences, chemistry and physics were in fair condition with the laboratory in chemistry much better than the laboratory for physics. Botany had no laboratory nor any equipment and it was noted that this course could not be taught effectively under the present condition.[295] The requirements for affiliation were not difficult. Many schools did achieve affiliation in the sciences. The standards were expected to be met if affiliation was to be granted.

Luling High School was one school that received a favorable report after a visit that the school was doing the required amount of work in the text and in the laboratory for affiliation in physics, and a recommendation for affiliation was included in the letter.[296] The Luling records are incomplete, and the existing records provide no indication why Luling High School does not show up as an affiliated school in any subsequent University of Texas catalogs. However, in the 1918-1919 catalog of the University of Texas, after the state of Texas had assumed the affiliation process, Luling High School was listed as a school with affiliation in physics.[297] Pittsburg another school among many that achieved

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[294] Letter, Taylor to Dupree, March 1915 (Center for American History Affiliated School Records, Box 4P306).

[295] Letter Taylor to Binkley, November 10, 1914 (Center for American History Affiliated School Records, Box 4P311).

[296] Letter Rice to Luling School, March 11, 1908 (Center for American History Affiliated School Records, Box 4P306).

[297] Bulletin of the University of Texas Catalogue, 1918-1919 (February 8, 1917): 454.

affiliation, received a favorable report. A letter was sent to the Pittsburg school noting that the school was applying for affiliation credits in chemistry, physics, physiography and physiology. The laboratory equipment was adequate for all the sciences and the student notebooks had been submitted. If the notebooks passed, then the visitor would recommend affiliation for these subjects.[298] In the University of Texas catalogue, 1914-1915, the affiliated schools were listed with the Pittsburg school having affiliation in chemistry, physics, physiography, and physiology.[299]

Student notebooks were the final step before a visit could be made to the requesting high school. If the student notebooks, in the subjects the high school was desiring affiliation for proved to be satisfactory by the faculty, the president of the university or some person designated by him would visit the high school.[300] In the 1904-1905 Catalogue, the language for the visit changed to reflect the new position at the University of Texas of the Inspector of Schools, with Professor John W. Hopkins the first inspector.[301] The notebooks had specific instructions, already delineated earlier, but a few more were indicated in the actual preparation of the notebooks. In a letter to Madisonville High School, the notes were to be original, not copied, and should be made in the laboratory with the aim for the student to learn to observe and record accurately and neatly the results of the

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[298] Letter Henderson to Pittsburg School, March 31, 1914 (Center for American History Affiliated School Records, Box 4P312).

[299] Bulletin of the University of Texas Catalogue, 1914-1915 (January 20, 1915): 600.

[300] Bulletin of the University of Texas Catalogue, 1900-1901 (1900-1901): 337.

[301] Bulletin of the University of Texas Catalogue, 1904-1905 (June 1, 1905): 429.

experiment.[302] In a letter to the same school one year later, the visitor of schools responded to a question from Madisonville as to whether the notebooks should be in pencil or ink and the answer was pen and ink[303] The university received many of these notebooks from schools desiring affiliation. One school, Malakoff High School, had sent the notebooks and examinations with a note requesting the notebooks be returned.. The reply from Henderson stated that the examinations had been destroyed, it was the practice to only return the notebooks. Of interest, though, was the information included that many papers came into the office and that the job to keep the notebooks organized was very difficult. In fact, the office received over five hundred sets and these were often mixed up.[304]

Student notebooks were sent to the University of Texas where appropriate faculty members would grade them. When the grading was completed, the notebooks and a form describing the notebooks, grade would be returned to the Committee of Affiliated Schools with a note to warrant or not to warrant. A grade of "to warrant" would be the last step before a visit was made to the requesting high school. Three examples of these forms include two for the Plainview school and one from the Pittsburg school. The two from Plainview were for physics and chemistry on March 25, 1911. The physics form did not mark either to warrant or not to warrant; only a question mark was placed by these choices. The written

[302] Letter, Visitor of Schools to Hale, September 30, 1914 (Center for American History Affiliated School Records, Box 4P307).

[303] Letter, Henderson to Hale, Madisonville School, March 9, 1915 (Center for American History Affiliated School Records, Box 4P307).

[304] Letter, Henderson to Phillips, Malakoff School, February 12, 1914 (Center for American History Affiliated School Records, Box 4P308).

comments reveal the reason for the doubt. Only a few specimen reports of laboratory experiments were submitted, and they indicated weak work in the laboratories and inadequate, easy experiments. The professor grading this work on the first form for physics makes the comment that given this work he would be unwilling to pass on the course work as a whole, but the examination papers were satisfactory, leaving the decision to the Committee on Affiliation.[305] A second form for chemistry, remarked that only a few picked pages of notes were submitted, and even those contained many errors in spelling and in equations. This faculty member, based on the notebooks submitted decided to not warrant the work satisfactory.[306] One other form graded the work from Pittsburg High School for chemistry. The only comment was that the work appeared to be in competent hands; therefore, the work was passed to warrant the inspection of the school.[307]

TEXTBOOKS

The concern over the lack of textbooks for the study of science occurred early. A letter from Noah Webster to Dr. Joseph Priestly in 1800 lamented the fact "that scarcely a branch of science can be fully investigated in America for want of books, especially original works."[308] The lack of textbooks and lack of any

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[305] Form to Warrant Physics, Plainview School, March 25, 1911 (Center for American History Affiliated School Records, Box 4P311).

[306] Form to Warrant Chemistry, Plainview School, March 25, 1911 (Center for American History Affiliated School Records, Box 4P311).

[307] Form to Warrant Chemistry, Pittsburg School, March 28, 1914 (Center for American History Affiliated School Records, Box 4P311).

[308] Noah Webster, Ten Letters to Dr. Joseph Priestly Letter IX (New Haven, 1800): 23.

standard for selecting textbooks left the high schools in the difficult position of selecting textbooks for their students. This problem over textbook selection caused a great deal of dissatisfaction. This lack of a uniform system for selection of textbooks hampered the improvement of teaching. While the University of Texas, through the affiliated schools program, began an attempt to suggest textbooks, the state legislature also acted. In 1897, the state legislature created a textbook board, and a uniform system of textbooks was adopted for the elementary schools.[309] Although the state of Texas initiated the State Textbook Board, the University of Texas continued to suggest textbooks for the affiliated schools, often stating that the state adopted book is not adequate.[310]

Another common theme from the three series of bulletins concerned the use of textbooks. Textbooks were suggested for each class, but the textbooks certainly had a lower priority for the classroom than did laboratory work. Several references were made to the marginal value of textbooks, with laboratory the focus of the class. The textbook should be for the teacher instead of the student. The textbook should not be discarded, but relegated to a second place.[311]

Even though textbooks did not enjoy a high regard for use in the classroom, two suggestions for a small science library were included. The library could foster interest in the science subject if available. The library should contain

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[309] Charles A. Culberson, Journal of the House of Representatives of Texas, Twenty-Sixth Legislature (January 14, 1899): 63-65.

[310] Letter, Henderson to King Palestine School, April 13, 1908 (Center for American History Affiliated School Records, Box 4P311).

[311] Bulletin 47, 102.

some more advanced material which, combined with some material of a more popular reading nature, would help the student realize that the classroom textbook was not a complete work on the subject.[312] In the bulletin from 1908 the same idea was expressed for the need of a small reference library for the sciences.[313]

Each science recommended textbooks that it was felt were suitable. The textbooks that were deemed suitable for recommendation should be written by practical high school teachers and not by theorists. The current textbooks in Texas normally included the series of textbooks that professed to furnish an adequate knowledge in a few short weeks. This series included the books Fourteen Weeks in Physics and Fourteen Weeks in Chemistry by J. Dorman Steele, published in 1878.[314] This series of books by Steele was designed to include simple, interesting language, a few of the principles of each subject, chemistry or physics, with practical applications, which could be taught in one term. In a subsequent edition, the book introduced many interesting comments and many practical questions throughout. Directions for extensive experiments appeared in fine print in the back.[315] Textbooks recommended for high schools should provide a framework for substantial yearlong work.

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[312] Bulletin 47, 75.

[313] Bulletin 106, 98.

[314] Bulletin 47, 85.

[315] John A. Nietz, The Evolution of American Secondary School Textbooks (Rutland, Vermont, Charles E. Tuttle Company, 1966): 146.

Chemistry

The earliest chemistry books used in American schools were usually reprints from those written in England, France or Germany with an American editor. The editing usually took the form of abridging the book, or adding questions, experiments, and pictures. The foreign texts typically were very technical in nature with few learning aids. When American authored textbooks appeared, these books were less technical and theoretical and emphasized the practical value of chemistry, making the books more teachable. Among some items added were questions, numbered paragraphs, different types of print, and illustrations and pictures. The topics covered varied greatly, with metals the only one covered in all textbooks. The next most popular topics were matter, water, hydrogen, oxygen, nitrogen compounds, acids and bases, salts, sulfur compounds, carbon compounds, halogens, and phosphorus compounds. These textbooks continued to improve, and in the late nineteenth century, these textbooks had standardized the content, the organization of subject matter, the presentation and teaching and learning aids. As the authors became more pedagogically conscious, the texts continued to become more attractive and teachable.[316]

The most common chemistry textbooks recommended for Texas high schools in chemistry, from the three series of bulletins were Introduction to the Study of Chemistry by Ira Remsen, published by Henry Holt in 1887, Descriptive Chemistry with Experiments by Lyman C. Newell in 1903 by D. C. Heath & Co., Essentials of Chemistry by John C. Hessler and Albert L. Smith in 1902 by

[316] Nietz, 149-152.

Benjamin H. Sanborn and First Principles of Chemistry by Raymond B. Brownlee and others in 1907 by Allyn and Bacon. [317] Examples of the use of these recommended textbooks come from forms completed for affiliation. Pilot Point High School listed the book by Brownlee and others in a form from 1916.[318] Pittsburg High School also listed the book by Brownlee for use in its chemistry classes.[319] The high school in Waco listed for their use in classes the book by Remsen.[320]

Physics

The earliest textbooks used in America were simply reprints from texts written in England. American editors, as with the chemistry textbooks, modified these textbooks for use in America by adding questions and providing summaries or outlines. The term "natural philosophy" was commonly used in the titles until the late 1890's; very few referred to the term "physics." Several authors used "physics" in the context, such as Richard Green Parker in his book, Compendium of Natural and Experimental Philosophy, in 1853.[321] American authors began writing textbooks and included improvements with inclusion of questions, use of

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[317] Bulletin 47, 77, Bulletin 106, 100, and Bulletin 210, 60-61.

[318] Form Pilot Point School to University of Texas, 1913 (Center for American History Affiliated School Records, Box 4P312).

[319] Form Pittsburg School to University of Texas, 1913 (Center for American History Affiliated School Records, Box 4P312).

[320] Form Waco School to University of Texas, 1906 (Center for American History Affiliated School Records, Box 4P321).

[321] Nietz, 130.

different sizes of type, italics or size, and with numbered paragraphs for easier reference.[322]

Virtually all the early texts used the classical terms of dynamics, hydrostatics, pneumatics, acoustics, and optics. These terms later gave way to more modern terms of power, liquids, air, sound, and light. Most textbooks included the aims for teaching of natural philosophy as to present useful scientific knowledge, to create an interest in scientific matters, to provide mental training, to present scientific applications and to provide directions for the use of apparatus.[323]

The content covered in the early texts had more consistency than most other subjects. These books nearly all included the areas of matter, mechanics, sound, heat, magnetism and electricity. While the very early textbooks included astronomy and meteorology, these were dropped by 1860. These textbooks covered the content but did not provide for student experiments. In 1880, eighty-one per cent of secondary schools offered physics courses with class experiments but no laboratory work. Only four out of 609 schools offered any type of laboratory work. This meant the textbooks most likely only provided experiments that the instructor would conduct as a demonstration.[324]

The most common recommended textbooks for Texas high schools included in all three series of bulletins were Henry S. Carhart and Horatio N.

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[322] Nietz, 132.

[323] Nietz, 130.

[324] Nietz, 131.

Chute's book High School Physics published in 1905 by Allyn & Bacon, and Elements of Physics by Ernest John Andrews in 1903 by the Macmillan Company.[325] In the 1908 Bulletin 106, a book by Robert Andrews Millikan and Henry Gordon Gale titled First Course in Physics published in 1906 by Ginn and Company was added to the suggested list.[326] In the 1910 Bulletin Number 150 another book by George A. Hoadley titled Elements of Physics published in 1908 by the American Book Company was also added.[327] As with chemistry high schools in Texas used the recommended books. The Honey Grove School in 1902 listed the Carhart & Chute book in their application form,[328] as did the Wortham School in 1914,[329] and the Pittsburg School.[330] New Braunfels High School used Millikan & Gayle's book in their application.[331]

Botany

More textbooks were written on botany before 1800 than on any other field of science, natural philosophy, chemistry and zoology. Many of these early

[325] Bulletin 47, 85, Bulletin 106, 77, and Bulletin 150, 3.

[326] Bulletin 106, 77.

[327] Bulletin 150, 3.

[328] Form Honey Grove to University of Texas, 1902 (Center for American History Affiliated School Records, Box 4P302).

[329] Form Wortham to University of Texas, 1914 (Center for American History Affiliated School Records, Box 4P321).

[330] Form Pittsburg School to University of Texas, 1913 (Center for American History Affiliated School Records, Box 4P311).

[331] Form New Braunfels to University of Texas, 1906 (Center for American History Affiliated School Records, Box 4P310).

books in botany dealt with the flora of particular areas. Books for the other sciences were mainly adaptations from European textbooks that were reprinted and popularized in America before any American written book became popular. Botany at this time was mainly the study of a particular given area, therefore the European texts were not easily adapted to the needs of this continent. Some European ideas were used, such as the theories of plant classification. Early American textbooks tended to be very technical and encyclopedic in nature. Nevertheless, eventually these books began to contain chapters on germination, vegetation, sap, roots, trunks, leaves, flowers and fruit. The first textbooks contained few illustrations with the expectation that the students would draw their own from observations. Eventually, illustrations found their way into the books, either as plates in the back or with the topics in the text. A textbook in 1896 provided the first instruction for the use of a microscope and other apparatus. Botany textbooks, in general suggested student activities earlier than the texts in the other science fields.[332]

Suggested textbooks for botany in the three series of bulletins contain a longer list of textbooks than any other science list, thirty-nine in total. The two most popular textbooks used in Texas high schools were the Foundations in Botany by Joseph T. Bergen and The Essentials of Botany by Charles E. Bessey. Bergen was an instructor in biology in the English High School, Boston. When he published his book, it was used for the half-year study in botany. The use of microscopes, apparatus, and reagents was given special attention. Bessey had

[332] Nietz, 91-109.

taught botany in several Midwestern universities, but his book was intended for use in high schools and colleges.[333]

There are only three references for botany textbooks used by Texas high schools. None listed the books by Bergen or Bessey; however, the three books listed by the schools were on the affiliated list. Pittsburg High School in 1911, on its application blank listed a book by Robert Greenleaf Leavitt titled Outlines of Botany for the High School Laboratory and Classroom published in 1901 by American Book Company.[334] The school in Cleburne, on its application form listed the book by William Chase Stevens titled Introduction to Botany in 1902 by D.C. Heath Company.[335] Another application form from Cleburne in the same year stated that they hoped to move botany to the third year of high school and to begin using a more advanced text, *Foundations in Botany* by Joseph T. Bergen published in 1902 by Ginn & Company.[336]

Zoology

Science was not taught in the early American Latin Grammar schools. However, Benjamin Franklin helped found America's first academy. In 1851, in Philadelphia, he proposed that natural history (zoology) be included. When the

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[333] Bulletin 47, 67-68, Bulletin 106, 110-112.

[334] Form Pittsburg to University of Texas, 1911 (Center for American History Affiliated School Records, Box 4P312).

[335] Form Cleburne to University of Texas, 1903 (Center for American History Affiliated School Records, Box 4P294).

[336] Form Cleburne to University of Texas, 1903 (Center for American History Affiliated School Records, Box 4P294).

first American high school opened in Boston in 1821, natural history was listed among the subjects taught. Although natural history did not become as popular in high schools as natural philosophy (physics), nevertheless, about half of the high schools in the latter half of the nineteenth century taught either natural history or zoology. Ultimately, after 1900 the separate subjects of zoology and botany began to be combined into the single subject of biology.[337]

As was true with the textbooks from the other subjects, American authors simply made revisions from the earliest texts in natural history from Europe. The study of natural history was never considered as practical as chemistry or physics, so it never become popular in the high schools. Content covered in these books consisted of seven main topics; protozoa, coelenterate, echinodermata, vermes, mollusca, arthropods, and vertebrata. The authors began to include illustrations, with books after 1900 having color pictures. Laboratory work was much slower to appear in textbooks than in the books for chemistry and physics. In 1875, a textbook included an emphasis on collecting and studying specimens.[338]

The textbooks from Bulletin Number 47 for Texas high schools listed one general zoology book by Richard Hertwig in 1902, A Manual of Zoology published by H. Holt and Company. Other textbooks were specialized, such as Handbook of Birds of the Western United States by Florence Merriam Bailey in 1902. Sir John Lubbock authored another specialty book titled, Ants, Bees, Wasps, a Record of Observations on the Habits of the Social Hymenoptera in

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[337] Nietz, 77-80.

[338] Nietz, 90-91.

1895, published by Appleton Books and of course, there was Charles Robert Darwin's Origin of the Species, published in 1884 by J. Fitzgerald.[339]

Although there are no application forms or copies of correspondence available listing the books used for Texas high schools, one can make the assumption that, as with other science subjects, high schools did, in fact, use books from the suggested list, if not, affiliation would not have been granted.

[339] Bulletin 47, 104.

ACTUAL IMPACT OF SCIENCE COURSES IN HIGH SCHOOLS

An observation of Table 4 reveals that during the 1900-1901 school year no sciences were affiliated in any Texas high school. In 1901, Blinn Memorial College of Brenham affiliated both chemistry and physics. The following year, other high schools were additionally affiliated in chemistry and physics: Calvert, El Paso, Houston, Marshall, San Angelo, Victoria, and San Antonio received affiliation in botany. For the next five years, 1903-1904 to 1907-1908 no new science courses were affiliated. In the school year of 1908-1909, Austin became the first school with affiliation in zoology. 1909-1910 to 1913-1914 again witnessed no new science courses affiliated for five years. Then in the year 1914-1915, two schools were affiliated in biology: Kerrville and Waco. Finally, the last science affiliated was general science in 1917-1918, with thirty-nine schools. No other science had been as popular at the beginning as was general science. The high schools that were affiliated in general science were well distributed over the state, with smaller schools in the majority. With the exception of Austin and El Paso, it appears that larger cities did not appear interested in the new introductory science course.

Sciences affiliated

1901-1902	Physics	Blinn Memorial College
	Chemistry	Blinn Memorial College
1902-1903	Physiology	Blinn Memorial College, El Paso and Marshall
	Botany	San Antonio

1903-1907	No new sciences affiliated	
1908	Zoology	Austin
1909-1913	No new sciences affiliated	
1914	Biology	Kerrville and Waco
1915-1916	No new sciences affiliated	
1917	General Science: Austin, Bellevue, Brownsville, Brownwood, Cameron, Colorado, Comanche, Cooper, Eagle Lake, Electra, El Paso, Floydada, Haskell, Hillsboro, Killeen, Livingston, Marshall, Mercedes, Milford, Navasota, Austin (St. Mary's Academy), San Angelo, San Augustine, San Benito, Santa Anna, Ozona, Palestine, Pecos, Richmond, Smithville, Taylor, Timpson, Athens, Franklin, Lockney, Marble Falls, Mount Calm, and Wills Point[340]	

Table 4: Date of Affiliation of the Sciences by the University of Texas

Table 5 indicates that the sciences made steady but not rapid gains in the number of courses taught. Physics took the position of being the most popular subject, then chemistry, with about half the number of classes that physics had. For the first few years, biology made little headway into the high school curriculum but increased in numbers as botany and zoology was discontinued. Botany and zoology had never been as popular as chemistry and physics had been in Texas high schools. Botany and zoology were half-year courses and were replaced by a full year of biology.[341]

[340] Bulletins of the University of Texas Catalogues, 1900-1901 to 1917-1918.

[341] Bulletin State Department of Education No. 320 (May, 1933): 9.

	Physics	Chemistry	Physiology	Botany	Zoology	Biology
1901-02	1	1	0	0	0	0
1902-03	6	7	4	1	0	0
1903-04	12	11	3	2	0	0
1904-05	13	11	3	2	0	0
1905-06	16	15	2	2	0	0
1906-07	20	20	4	4	0	0
1907-08	35	23	7	7	0	0
1908-09	58	36	15	10	1	0
1909-10	86	44	20	14	1	0
1910-11	86	44	25	16	1	0
1911-12	94	55	38	16	2	0
1912-13	108	58	51	20	4	0
1913-14	122	66	49	23	6	0
1914-15	145	80	61	25	8	2
1915-16	155	88	77	23	9	2
1916-17	178	98	83	26	8	6
1917-18	203	117	93	27	8	19

Table 5: Number of Affiliated Subjects[342]

An examination of Table 6 displays, by year, the number of science subjects per school affiliated. Some schools achieved affiliation in only one science subject, usually physics or chemistry, while other schools were affiliated

[342] Bulletins of the University of Texas Catalogues, 1900-1901 to 1917-1918.

in from two subjects to a high number of six sciences. The maximum number the University of Texas only affiliated was six subjects. By the school year 1917-1918, seventy per cent of high schools had achieved affiliation in two, three, or four subjects. This same year, the last of affiliation by the University of Texas, 87.9 per cent of the high schools in the state were affiliated in one or more science courses. 203 high schools out of 231 had science affiliated course. From a very small beginning, only one per cent of the schools in 1901-1902 had science affiliated courses to 19.3 per cent in four years, to 56.1 per-cent of schools in 1908-1909, to over 87 per cent the last year of affiliation by the University of Texas, 1917-1918. While science courses started appearing fifteen years after the affiliation program, in spite of the additional teacher training needed and the expense of establishing laboratories with apparatus for teacher demonstrations and individual student laboratory work, the sciences achieved almost 88 per cent in the number of schools offering affiliated courses.[343]

[343] Bulletins of the University of Texas Catalogues, 1900-1901 to 1917-1918.

Year	One	Two	Three	Four	Five	Six	Total Schools with Science Affiliation	% Schools Affiliated in Science	Total Schools Affiliated all Subjects
1901-02	0	1	0	0	0	0	1	1.1	92
1902-03	1	2	2	1	0	0	6	6.2	98
1903-04	3	6	3	2	0	0	14	14.1	99
1904-05	1	8	2	3	0	0	14	14.3	98
1905-06	8	9	4	0	0	0	21	19.3	109
1906-07	14	8	7	1	0	0	30	23.6	127
1907-08	10	14	14	2	0	0	40	28.8	139
1908-09	27	29	16	6	0	0	78	56.1	139
1909-10	30	33	17	12	2	0	94	68.1	138
1910-11	27	31	20	13	4	0	95	69.3	137
1911-12	23	34	20	17	8	2	104	70.2	148
1912-13	27	33	22	20	9	2	113	72.9	155
1913-14	34	39	25	20	10	4	132	80.5	164
1914-15	33	39	35	29	13	3	152	87.4	174
1915-16	30	40	39	40	9	6	164	88.6	185
1916-17	31	47	42	42	13	5	180	90.5	199
1917-18	31	46	47	50	23	6	203	87.9	231

Table 6: Number of Affiliated Subjects[344]

[344] Bulletins of the University of Texas Catalogues, 1900-1901 to 1917-1918.

Courses of Study

In 1901, the Committee of Affiliation published two model programs of study, one for a four-year high school and the other for a three-year high school. These are probably the first programs ever published in the state of Texas for other high schools to use as models for the sequence of their own courses. The four-year course for the first year suggested the science courses of physical geography, physiology and hygiene. The second year suggested the same two courses. The students had the option of what year each course would be taken in, but each student would take both courses. For the third and fourth year, the same method was used: chemistry, physics, botany or zoology were listed for both years. The students chose two years of science work, either chemistry for a year, physics for one year, or botany and zoology for one year. The suggested course for the three-year school was identical, except for the fourth year. The first two years the students had the choice of either physical geography one year and then physiology and hygiene the next, or vice versa. The third year, the student had to select from chemistry, physics, or botany and zoology.[345] Austin Public High School published a course of study in 1906-1907 for their four years of study. The first year did not list any science course work. The second year, first term required physical geography while the second year, second term required physiology. The third year, the sciences of zoology and chemistry were listed for both the first

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[345] Ernest H. Hereford, Dissertation, Certain Influences Bearing upon the Development of Public High School Programs of Study in Texas in the Last Half Century (June 1931): 88-89.

term and the second term as optional courses. The fourth year also listed the science courses of physics and botany as optional for both school terms.[346]

Another proposed course of study was released by the Committee on a Uniform Course of Study at the State Teacher's Association meeting in San Antonio in 1906. For the sciences, this report recommended physical geography and physiology for the first year. The second year, the same two courses, while in the third year botany was recommended. In the fourth, either physics or chemistry was recommended.[347] This was another group suggesting course scheduling, and the University of Texas was not alone in proposing courses of study, this recommendation followed the University's suggested course of study.

The high school in El Paso listed in its course catalogue published in 1907-1908 three separate course of work for students: the commercial course, the general course, and the college preparatory course. None of the three courses recommended any sciences for the first year. In the second year, the general course, and the college preparatory course listed physical geography for the first term and physiology for the second term for the second year. Then in the third year, the commercial course listed physical geography and physiology courses, while the general course and the college preparatory course both recommended physics. During the fourth year of high school, the commercial course listed

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346 Hereford, 66.

347 Texas School Magazine "A Uniform Course of Study for High Schools," (April, 1906): 8.

physics. The other two courses, general and college preparatory, recommended chemistry.[348]

The Midland school board also published their course schedule for the school year 1913-1914. Science courses were recommended in all four years. In the first year, physical geography, in the second year, physiology, in the third year, physics and in the fourth year, chemistry. The schedule also provided some detail on individual course work. Physiography had thirty-two standard exercises and the physiology course had thirty experiments and exercises. The third year of physics required thirty to thirty-five standard experiments with the pupils working singly or in pairs. The laboratory period lasted from forty to eighty minutes once each week. Fourth year chemistry would contain standard experiments, one period each week. The course was to conform, as nearly as possible, to the first year of chemistry at the University of Texas.[349] It should be noted that during this school year 1913-1914, Midland received affiliation in physics, physiography, and physiology.[350] Chemistry affiliation was obtained the following school year, 1914-1915.[351]

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[348] El Paso Public Schools Course of Study for High School (1907-1908).

[349] Midland Public Schools "Synopsis of Course of Study of the High School," (September 1, 1913).

[350] Bulletin, Catalogue, 1913-1914, 563.

[351] Bulletin, Catalogue 1914-1915, 599.

SECTON FOUR

Chapter Eight: Conclusion

The first half of the nineteenth century was a period during which control of education by the church gave way to control and support by individual states of the Union. The nation had expanded beyond its dreams. Industry had experienced a revolution brought about by the harnessing of water and steam. Transportation had effectively adapted to steam power and followed the pioneer into the Western frontier. Towns along the Eastern seaboard had become cities thanks to the growth of manufacturing while the westward movement of the frontier pioneers had stretched the nation's boundaries. There was also a growing spirit of equality among the people that did much to erase class lines.

The last half of the nineteenth century saw the rise of a middle class whose children stayed in school longer and longer as a result of the technical demands of the Industrial Revolution. There evolved, according to Cubberley, "free, tax-supported, non-sectarian, and publicly controlled and directed schools, to serve the needs of society and the State."[352]

With the development of public education, there was a strong motive to provide an adequate education for more that just the few who were college bound. Nineteenth century schools were no longer confined to the privileged few, but

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[352] Cubberley, An Introduction to the Study of Education, 10.

now provided a free, tax-supported education for all.[353] A limited education offered to only a few gave way to a general education for all American youth during this period.

The early American Latin Grammar School curriculum did not include any natural sciences. However, the subsequent academy schools brought about an increasingly important role for the natural sciences in their curriculum. As the nineteenth century progressed, the academies were moving away from their older natural science emphasis of technical or highly scientific studies and replacing it with an education in popular science. The public high school movement that included many sciences followed the academies.[354]

The first high school, the Boston English Classical School, opened in 1821, included natural philosophy, as did the Girl's High School in 1826. In 1857, Massachusetts passed the first state law requiring that natural science studies be included in the school's curriculum. This introduction of natural sciences to the public secondary school was in answer to the interest and development of the natural sciences during the first half of the nineteenth century.[355] The earliest recognition of a natural science course for college entrance was physical geography at Harvard and Michigan in 1870. Natural philosophy was first recognized for college entrance credit at Syracuse University in 1873, followed in

[353] W.S. Sutton, "Educational Progress During the Nineteenth Century," Texas School Magazine (Volume VII, Number 1, March, 1904): 5.

[354] Walter B. Hendrickson, "Science and Culture in the American Middle West," Isis (Washington, D.C., The Smithsonian Institute, Volume 64, Number 223, September 1973): 337.

[355] Inglis, 506-507.

1876 by entrance examinations at Harvard in botany, physics, chemistry, and descriptive astronomy. Laboratory work as part of the course of study for natural science, admission credit began at Harvard in 1887. The study of the natural sciences in the second half of the nineteenth century expanded to include all of the science fields, so that offerings in public secondary schools varied widely. The Committee of Ten in 1892 began the organization and standardization of curriculum for American high schools.[356]

The Committee of Ten standardized science instruction by providing the order in which the sciences should be studied, and by emphasizing laboratory work and the study of some natural science by every student. While the committee had begun to effect much-needed standardization, their work did receive some criticism. The planned courses of study it suggested did not meet the needs of students who left school before graduation. Subjects were not organized by the scholarly capacities of the students; some of the natural sciences were considered to be of questionable value, such as astronomy, geology and meteorology, which were later dropped; and the committee's recommendations failed to recognize the need to relate the study of natural science directly to the student's life. However, this report by the Committee of Ten began a momentum nationally for standardization of courses for the public high school.[357] The public secondary school had made the transition from a European form of educational hierarchy to one of American design and change, moving from classical language

[356] Inglis, 507-508.

[357] Inglis, 508-509.

studies to practical and useful coursework. A limited education offered to a few gave way to a general education for all American students.

Many stimulating developments took place in the world of science during the years from 1886-1917. While these developments were exciting, it appears that the growth of science in general had more of an impact on education than any one particular scientific event. These years witnessed science becoming an established part of the curriculum in public secondary schools.

As science courses became established in the curriculum, the approach to teaching science also changed. In the years from 1850-1880, most teaching, as reflected by a textbook was factual and encyclopedic. Teaching of the sciences focused on mental discipline with technical and factual acquisition. The period from 1880-1900 witnessed the additions of new science courses to the curriculum as the importance of science became recognized by society. While teaching methods still focused on mental discipline, memorization, and factual textbooks, laboratory demonstrations began to appear in the classroom. From 1900-1920, the sciences established a firm place in the curriculum, and scientific methods were applied in education. Memorization and factual textbooks continued to have a part in the curriculum, but practical household science, the scientific method and laboratory experience for each student were also stressed.

Science became an important part of the secondary school curriculum. Scientific progress made educators aware of the importance of science to mankind and of the value of scientific thinking and techniques in the solving of problems.

Use of the scientific method became a way of making decisions and performing tasks.

The University of Texas was a key contributor to the dramatic change in the secondary curriculum during this time, 1886-1917. As the nation's secondary schools struggled to become established, the high schools in Texas also struggled to become part of a state tax-supported school system. The curriculum in each school was highly individualistic, depending on whether their function was to prepare students for continued study in college or to provide students with the skills required for employment after their secondary education was furnished. Teacher certification progressed from each county issuing its own teaching certificates to standardized certificates from schools of pedagogy established in colleges across the country. America secondary schools strove to make secondary education more democratic and readily accessible to increasingly more students.

No standards existed for superintendents to organize their schools' curricula. The new high schools had little which distinguished themselves from the private academies until The University of Texas began the affiliation effort, and high schools acquires their own identity. By setting standards for affiliation, the university actually produced a uniform high school curriculum comprised of English, mathematics, history, Latin and Greek.

As descendents of the academy, high schools included science courses in the curriculum, although it took several years before the university recognized these science courses for affiliation. Natural philosophy, or physics, had enjoyed great popularity in the academies. It also appeared in the new high schools along with other subjects such as physiography, botany, zoology and chemistry. But because of poor teaching methods, poorly trained teachers, and practically no laboratory facilities, this course work was regarded as having little value, and therefore not worthy of affiliation for admission to college.

Perhaps the university could have done more earlier to raise the standards for science subjects, but the cost of laboratories and apparatus was a heavier financial burden than most schools could bear. These early high schools struggled to find certified teachers, pay a reasonable salary to keep good teachers, erect buildings suitable for school use and expand the curriculum from three years to four years. Laboratories had to wait until the high schools became firmly established in the communities and had the support of the school board and local citizens. The university officially began to affiliate science subjects in 1901-1902. In bulletin after bulletin, the university pointed out the defects of existing science instruction and provided recommendations for methods of improvement.

In the first years of the affiliation program, the university accredited high schools with the intent and attitude that the schools were considered as auxiliary and subsidiary high schools. However, by the end of the affiliation program it was stated that the primary aim was to help build up efficient high schools.[358] While high schools were encouraged to apply for affiliation in articles by high school superintendents and principals, in the final year of affiliation, only 34.75 percent of the state's high schools could count affiliation in any subject. However, these affiliated high schools contained 69.61 percent of the secondary students in the

[358] Letter, Henderson to Speer, Mt. Pleasant School, October 10, 1912 (Center for American History Affiliated School Records, Box 4P308).

state. In a letter to President Houston of the University of Texas, Henderson relates the results of an investigation made of students from affiliated schools. Of five hundred seventy-nine students enrolled, three hundred one students were from affiliated schools--almost fifty-two per-cent.[359]

Clearly, the University of Texas rendered untold value to the standardization of public high schools. This close relationship between the university and the high schools naturally caused many high school graduates to apply to the University of Texas for admission for their college work resulting in a strained relationship with other colleges in the state.

In November 1912, at the thirty-fourth annual meeting of the Texas State Teachers Association, the general topic for discussion was greater uniformity of college admission requirements. In the ensuing discussion, with nearly all of the colleges of the state represented, an agreement was created and signed by the presidents of the colleges present. This agreement recognized that the University of Texas had developed a comprehensive system of school visitation for the promotion of higher standards in the secondary schools. Since this system had been developed at taxpayer expense, all of the colleges were entitled to use this classification system. The colleges that signed this article agreed that they would admit graduates from the University of Texas list of affiliated schools.[360] However, this proved to be only a temporary measure. A letter from J. L. Henderson to the superintendent of Orange High School explains that people from

[359] Letter, Henderson to Houston, January 6, 1908 (Center for American History President Papers, Box 4P478).

[360] Bulletin of the University of Texas 288 (July 23, 1913): 26-27.

normal schools and A&M College had become jealous of the university's relationship with the high schools.[361]

The Texas State Teachers Association, during their December 2, 1916, meeting, passed a resolution recommending "that all problems involving the common and possibly antagonistic interests of the high schools, colleges and universities of Texas are entitled to consideration by a tribunal in which all have representation…that each party has vital interests which can never be adjusted satisfactorily and equitable by the sole action of a single institution of higher learning."[362] This statement helped transfer control of the affiliation system to the State Department of Education. With this transfer, the affiliation program at the University of Texas ended.

Looking back on this period an observer can only speculate as to the character of the state's secondary school courses had it not been for the influence of the University of Texas. Without complete faculty minutes from the late 1800's, one can only contemplate the agreements and disagreements of the faculty that surround the beginnings of the affiliation program. Obviously, the University of Texas faculty members were aware of the University of Michigan affiliation program, shown by a direct reference to the Michigan program and believed that the program was beneficial. One fact remains clear; the University of Texas began a similar program. Many questions remain unanswered by the available records.

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[361] Letter, Henderson to Stover, to Orange School March 26, 1917 (Center for American History Affiliated School Records, Box 4P310).

[362] Twenty-First Biennial Report State Superintendent of Public Instruction State of Texas (September 1, 1916 to August 31, 1918): 79-80.

While the faculty voted to initiate an affiliation program, did all the faculty members enthusiastically embrace the program? Were some members openly supportive and were any members openly opposed to the program? Did the Latin and Greek professors understand the implications and changes that the coming of a new curriculum of science and modern language affiliation would bring to the classic language department?

Two facts are revealed from the faculty minutes, a desire to create auxiliary high schools that allowed some control and standardization by the University of Texas faculty over the curriculum in the high schools and increased the exposure of the university to the students of Texas, thus providing a more academically qualified student for university work.

In the late 1800's, the University of Texas was only one of several public and private colleges in the state of Texas. Why did the University of Texas begin this affiliation program, instead of another university? Did these other universities not realize the chaotic conditions of the state's high schools? If the problem was realized, did financial concerns prohibit these other universities from beginning an affiliation program or did the faculty not want to extend the effort needed?

Did the University of Texas faculty members perceive the affiliation program as an extension of the universities mission to become a university of the "first class?" Was this even a part of a faculty member's responsibility? Did all faculty members willingly accept the added responsibilities of school visits and the grading of the high school examination papers?

Some conclusions can be made however. These early beginnings of the affiliation program did require a full faculty commitment to teaching. A department of pedagogy was established and by 1916, high school teachers trained at the University of Texas, dominated a list of the secondary teachers in the state. However, the success of the program eventually led to the end of the program. As the program increased in number of high schools affiliated, the influence of the University of Texas also increased. The other colleges in the state recognized this growing influence and began a movement to transfer the accreditation of the state's secondary schools from the University of Texas to the Texas State Department of Education.

By the end of the affiliation program, the University of Texas had not only become a great university, but also had created a statewide standardization program for secondary schools, completing a statewide system of education from elementary school to the university. Without the great unifying influence of the University of Texas Affiliation Program, Texas schools may well have continued to operate in chaotic fashion far into the twentieth century.

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VITA

Larry Joe Kelly was born in Tulsa, Oklahoma on May 26, 1946, the son of Wallace Kelly and Evelyn Kelly. After completing his work at Will Rogers High School, Tulsa, Oklahoma, in 1964, he entered Abilene Christian University in Abilene, Texas where he received his Bachelor of Science degree in May 1968. Larry began working in the family business, Kelly Tractor & Implement Co., in Tulsa, Oklahoma, until the business closed in 1982. Larry then began work as a general manager for a U-Haul center in Tulsa, Oklahoma until the summer of 1994, when he returned to Abilene Christian University for a post baccalaureate teaching certificate. Larry began teaching eighth grade Earth science at Bowie Junior High School in Odessa, Texas, where he remained for four years. During those four years Larry received his Masters of Education degree from Sul Ross State University, in Alpine, Texas, in 1997. Larry moved to Austin, Texas, in 1998 to enroll in the doctoral program at The University of Texas at Austin and continued teaching eighth grade Earth science for two more years, one year at Covington Middle School in Austin, Texas, and then one year at Hopewell Middle School in Round Rock, Texas. The last two years Larry has continued his studies while attending The University of Texas at Austin full time.

Honorary and professional memberships include membership in American Educational Research Association, American Association for Teaching and Curriculum, Society for the Study of Curriculum History, Kappa Delta Pi and Pi Lambda Theta.

Larry was married to Mary Ann Carruth on June 11, 1966, and is the father of two sons, Jeffery Wallace and Gregory William.