Science in Kansas: The Early Years, 1804-1875

by John M. Peterson

Introduction

The beginnings of science in Kansas have received little attention in the many volumes devoted to the history of the state. More specifically, science is mentioned in accounts of the territorial and early statehood periods, and it is not until much later that science is allotted some attention. In this study I propose to search out and briefly describe at least some of the scientific endeavors pursued in Kansas from the earliest times until 1875. It is my hope that a survey of the scattered but not negligible activities in several scientific disciplines will shed some light on later and better known developments. The closing date, 1875, is arbitrary, but serves to keep the subject within bounds and is, I believe, late enough to reveal many of the persons, trends, and activities that became important to Kansas science in later years.

“Science” and “scientific activities” in this article will be taken to mean subjecting natural phenomena to systematic observation, classification and experimentation, and will include the knowledge so derived and the teaching of those techniques and that knowledge to others. In mid-nineteenth-century Kansas, scientific activities mostly were concerned with what we now call earth and life sciences—geology, mineralogy, zoology, botany, entomology, ornithology, and meteorology. Physics, chemistry, and astronomy played a lesser role until laboratory facilities and instruments became available. Mathematics, whether as a science or a tool of science, received much attention in the schools. Certain subjects which now occupy the attention of many scientists—biochemistry, bacteriology, and genetics, for example—did not yet exist.

Before recounting the scientific activities carried on by the early European visitors, we should reflect that long before the first Europeans ventured into Kansas there were people here who had a great deal of knowledge about its natural resources. Though we seldom think of them as possessing scientific knowledge, what they knew about plants and animals closely paralleled that sought by the early scientists of European descent.

I am referring to the hunter-gatherer peoples who came into Kansas as early as twelve thousand years ago. They lived by hunting and gathering, and they moved from place to place in consonance with the yearly cycle of plant food production and the annual movements of game animals. As botanists they recognized many plants, knew their habitats and properties, when they could be used for food, and what parts were useful in making shelter, clothing, utensils, tools, weapons, and ornaments. As zoologists they were close students of the habits and life cycles of many animals, not just the large game species but also smaller mammals, as well as birds, fish, mollusks, turtles, and snakes. All of these were used as food at one time or another and provided the raw material for clothing, shelter, tools, and ornaments. The hunter-gatherers even can be credited with some knowledge of mineralogy. Remarkable stone points attest to a knowledge of the properties of certain kinds of rock. They also sought out other lithic materials for ornaments, used hematite as body paint, and discovered that heating chert would improve its knapping qualities.

Much later, in the Ceramic Period, additional kinds of knowledge were acquired. The Indians found the sources of potting clay to make pottery; discovered local materials for tempering the clay; and learned how to fire the pottery with locally available fuel. The basic techniques may have been brought in from elsewhere, but experimentation was needed for adaptation to local materials. When plant cultivation began, possibly about the same time that pottery making was introduced, another whole range of information about plants, soils, and cultivation techniques was slowly accumulated.1

John M. Peterson, a native of Logan County, has B.S. and M.A. degrees from the University of Kansas. Before his retirement he was employed in budget work for the U.S. government in the Washington, D.C., area. Mr. Peterson now devotes much of his time to Kansas history and archeology.

1. Many sources could be cited for these paragraphs, but a convenient presentation may be found in Patricia J. O’Brien, Archeology in Kansas, University of Kansas, Museum of Natural History, Public Education Series no. 9 (Lawrence: 1964), 20-53.
The Plains Indians' knowledge of their natural environment was not recorded in printed form, but much of what they knew was passed on to the early explorers and settlers.

Though the Indians' natural science, for the most part, was not recorded, much was passed on to the early settlers and explorers, and even nineteenth-century scientists sometimes learned of new species or a new plant usage from the Indians.²

The Early Explorer-Scientists, 1804-1854

Once the Louisiana Territory was added to the United States in 1803, the next order of business was to determine what President Jefferson had acquired for $15 million. Not much was known about this vast area west of the Mississippi although a few traders and explorers had ventured into its eastern fringe. Boundaries were rather vague, and features—geology, natives, flora and fauna, and mineral resources—were little known but were of much interest to government officials and the public. During the next three or four decades the U.S. government sponsored a number of expeditions, beginning with that of 1804-1806 headed by Lewis and Clark, to explore the new territory. Private parties also entered the new lands for a variety of purposes—fur trading, prospecting, opening commerce with Mexico, learning about and trading with the natives, finding new plants and animals, or just adventuring.

Science in the United States in the first few years of the nineteenth century was primarily concerned with inventorying natural objects using the Linnean system

of classification. Much progress had been made during
the eighteenth century in collecting, classifying, and
describing the animals, plants, fossils, and other natural
forms of the eastern part of the country, although the
task was far from complete. Of greatest interest was the
identification of new species and genera, but species
habitats, behavior, and distribution also began to be
recognized as scientific interest. The sudden accession of
an enormous western territory, presumably filled
with innumerable new genera and species, stimulated
American collectors and scientists to greater efforts and
attracted the attention of many of their European
colleagues.

In the early 1800s American scientists, almost all of
whom were amateurs, began to form associations and to
establish journals in which the results of their work could
be published. Major study collections also were formed
and rapidly enlarged for use in identifying and describing
new species. In the field, scientists spent most of their
time observing and collecting, and therefore the tasks of
identification, classification, and description until they
returned home. Some scientists became specialists and
devoted much of their time to identifying and describing
specimens collected by others. Consequently, explorers
and travelers who were not scientists but had some
training in collecting could gather specimens in the
West and forward them to eastern specialists for examination
and further scientific processing.

Philadelphia, the home of two major societies with large collections
and established journals, was the primary center of
this activity, but New York, Washington, New Haven,
Cambridge, and St. Louis also became important by
mid-century.

Only a few of the many expeditions to the West will be
mentioned here; mainly those with serious scientific
intentions which spent some time in what now is Kansas.
A few others which skirted the borders or spent
considerable time in a nearby area will be noted because
they contributed knowledge about plants, animals, or
geological formations also found in Kansas. Three main
routes led to the West; the river route up the Missouri
and its tributaries and the two land routes which became
known as the Oregon and Santa Fe trails. The route up
the Missouri did not enter Kansas but followed its
northeastern border; the Oregon Trail ran through the
northeastern quarter; and the Santa Fe Trail traversed
Kansas from its eastern border to near its southwestern
corner.

All of Kansas except for a small part of the south-
western section was included in the Louisiana Purchase.
Its natural history was almost completely unknown
although many of the birds, animals, and plants native
to Kansas had been identified, named, and described
from specimens collected in the eastern parts of the
country. The first expedition to actually spend much
time in Kansas, that of Maj. Zebulon M. Pike in 1806-
1807, is not of major concern even though his instruc-
tions were to observe geographical structure, natural
history, the native population, and to “collect and pre-
sure specimens of every thing curious in the mineral or
botanical worlds, which can be preserved and are
portable.” Pike’s main purpose was to make contact with
the Indians and to impress them with the strength and
good intentions of the United States, but he was not
given the needed resources and his party suffered great
hardships. Consequently, there was little or no collecting.
He did report extensively, however, on the natives and
submitted some geographical data; this despite the
confiscation of the greater part of his papers by Spanish
authorities. Unfortunately for his reputation, Pike is
chiefly remembered for concluding that the prairies
were “incapable of cultivation” and might “become in
time equally celebrated as the sandy deserts [sic] of
Africa…”

Significant scientific collecting in Kansas began with
the Stephen H. Long Expedition in 1819-1820. This
expedition, largely a military effort, advanced up the
Missouri River to Council Bluffs, Iowa, and spent the
winter there. Before resuming travel in 1820 the military
party was eliminated, but the scientific group, though
funds were reduced, proceeded under Long’s leadership
to the Rocky Mountains, then south to what now is
southern Colorado where, in July, the party was split.
One group under Capt. John R. Bell made its way to Fort
Smith down the Arkansas River while the other party
under Major Long reached the same point by a more

3. This data was valuable as raw material for the development of
theories which then could be tested and modified as additional data
was reported. In the Linnean system of classification, the grouping of
natural objects into larger categories proceeds from species to genera,
families, orders, classes, and phyla.

4. In geology, probably the most advanced of the sciences in the
early 1800s, European geologists already recognized the differing
origins of various minerals and rocks, the existence of strata extending
across large areas, and the usefulness of fossils in identifying strata. In
the United States, geologists applied these concepts in their study of
American formations.

5. Z. M. Pike, An Account of Expeditions to the Sources of the Missis-
sippi ..., (Philadelphia: C. and A. Conrad and Co., 1810, reprint ed.,
1996), pt. 2, 108. Pike left the St. Louis area on July 15, 1806, and arrived
at Santa Fe on March 3, 1807, after passing through parts of Missouri
into north-central Kansas, then south to the Arkansas River which he
followed to the mountains where he turned south into Spanish

6. Ibid., appendix to pt. 2, 8.
southern route down the Canadian River. Thomas Say, expedition zoologist, went with Bell while Edwin James, botanist and geologist, traveled with Long.

The Long Expedition was the first to provide extensive collections from the West. Specimens included sixty prepared skins, several thousand insects of which seven hundred or more were thought to be new to science, between four hundred and five hundred species of plants, and numerous minerals, shells, and other objects. Also brought back were many descriptions of birds; extensive accounts of Indian life, customs, physical characteristics, and languages; many sketches; numerous observations of geological formations and rocks; and many calculations of latitude and longitude. Even though most of the journals and scientific notes were lost when three men deserted Bell's party, the arrival in the East of the expedition's specimens and reports stirred the interest of the public, as well as that of the scientific establishment.

Thomas Say (1787-1834) was the first distinguished naturalist to set foot in Kansas. A native of Philadelphia, he was a charter member of that city's Academy of Sciences.

Natural Sciences and an important contributor to the work which made Philadelphia the center of scientific activity during the first half of the nineteenth century. Primarily an entomologist, he also worked in other fields. Representative of the science of his time, his primary concern was to collect, classify, and describe the many new forms being found in the West. When he saw a new insect he could not refrain from collecting it, regardless of the circumstances; he once captured a new beetle while in a solemn conference with the leaders of the Kansa Indians in a lodge on the Kansas River.8

Most of the Long Expedition collections were sent to Philadelphia. James wrote a general report based on the remaining journals of the expedition's participants, and Say published many descriptive articles on insects, shells and fossils, largely those collected by the Long party. Thus, the expedition made a significant contribution to the scientific knowledge of the time, as well as stimulating much interest in the natural history of the territory beyond the Mississippi.

Only three years after the Long party's sojourn, a German, Paul Wilhelm, Duke of Württemberg, stopped briefly in Kansas. Representative of the European traveler and collector who on his own initiative visited the West in the first half of the nineteenth century, the Duke had considerable training and experience in the natural sciences, and made four trips to North America and several exploratory ventures elsewhere. His only visit to Kansas was in 1829 on his way to the upper reaches of the Missouri River. On a short trip up the Kansas River, he visited a camp of the Kansa Indians. He intended to go farther but was turned back, not by the many bears he saw but by the hordes of mosquitoes.9 While on the Missouri he collected plants, butterflies, insects, and birds which undoubtedly included many species native to Kansas. His collections were taken to Germany and housed in his museum at Mergenthalen, along with the products of his many other travels, and presumably were studied by European scientists. The narrative of his 1822-1824 trip, published in Germany in 1825, contained many observations and astute comments, particularly on American natives, relations between the races in America, distribution of plants, and weather phenomena.

About a decade after the Duke's visit, two leading members of the eastern scientific establishment visited Kansas. They were John Kirk Townsend, M. D. (1809-1815), a skilled ornithologist from Philadelphia, and Thomas Nuttall (1786-1859), an Englishman who was among this country's foremost botanists. The two were on an extensive collecting trip; Townsend was sponsored by the American Philosophical Society and the Academy of Natural Sciences, both of Philadelphia, while Nuttall was collecting for Harvard College where he lectured on natural science and was curator of the botanical collection. In St. Louis they arranged to travel to Oregon with Nathaniel J. Wyeth's second expedition, a mixed group of missionaries, immigrants, and fur traders. The party of seventy men and two hundred fifty horses left Independence, Missouri, on April 28, 1834.10

Wyeth's expedition went up the Kansas River to the Blue River, then north to the Platte River valley. There they turned westward. This route, long used by fur traders, later became the first part of the Oregon Trail. The party moved rapidly and spent less than two weeks in Kansas, but Townsend reported seeing and collecting many birds in that period. Nuttall, who had collected on the upper Missouri in 1810 and in Arkansas and Oklahoma in 1819, found "no end of plants" as the party moved west. Along the Platte, Townsend became particularly enthusiastic, saying that many of the abundant birds had not been seen before by naturalists. Of one grove on the edge of the river, he commented, "I think I never before saw so great a variety of birds within the same space."11 His teeming game bag delighted him, and he reported that Nuttall was finding dozens of specimens daily. Of course, they were not in Kansas at this time, but most of the birds and many of the plants were species also to be found in Kansas.

Townsend and Nuttall journeyed to the West Coast, and Nuttall even went on to visit Hawaii. When their specimens began to appear in Philadelphia, scientists were much impressed by the great number of new species. John James Audubon, then prosecuting his great work on American birds, went to Philadelphia in September 1836 to see them. In October he obtained ninety-three of the bird skins from which he drew seventy figures on over forty plates. These made up over one-tenth of the "Elephant Folio," as his master work was called.12 Most of Townsend's new birds were from the Rocky Mountains and points west but two, the prairie finch and the

11. Ibid., 190.
systematic observer, had received some training from Joseph N. Nicollet, a French scientist who introduced American scientists to the use of fossils in correlating geological strata and barometric measurements to determine altitude.44 Relying on this scientific knowledge and collecting experience, Fremont seldom took technical assistants, other than a topographer, with him. In 1842 his party generally followed the Oregon Trail to Wyoming and returned down the Platte and Missouri rivers. The plants he collected were submitted to John Torrey, a botanist who prepared a twelve-page catalog mentioning numerous specimens collected in Kansas.39 In 1843-1844 Fremont varied his outbound route by going up the Republican and Prairie Dog rivers before moving over to the Platte. Returning from Colorado, he followed the Santa Fe Trail into Kansas, cut north to the Smoky Hill River which he followed most of the way to its mouth, and then went back south to the Santa Fe Trail. This was the most extensive journey through Kansas since Long’s trip, but many of Fremont’s specimens were lost in a wagon accident and a flash flood. Even so, enough remained for a report on plants by John Torrey and one by James Hall, one of the country’s senior geologists, on rock specimens and fossils, some of which were from Kansas. Fremont also wrote at length on his observations and mentioned the good soils in the region’s eastern part and the “unbroken verdure of the buffalo grass” in what now is western Kansas, thereby beginning the refutation of the “great American desert.”48 In the fall of 1848 Fremont again crossed Kansas. He went up the Kansas and Smoky Hill river valleys to the Hays area, then cut down to the Arkansas River and followed the Santa Fe Trail to Bent’s Fort in Colorado. Frederick Creutzfeldt, a botanist, was in the party, but the trip ended in disaster and no scientific reports concerning Kansas were produced.49

Three other expeditions in the 1840s deserve brief mention. In June 1846, Lt. Col. W. H. Emory, assisted by three other officers of the Corps of Topographical Engineers, accompanied a military column headed for Mexico. The engineers’ main duty was to determine

13. Louise Barry, The Beginning of the West, Annals of the Kansas Gateway to the American West, 1541-1854 (Topeka: Kansas State Historical Society, 1972), 472-73. The bird Audubon saw may have been the Louisiana parquet or parrakeet, which ranged to Kansas and, many years later, was determined to differ slightly from the Carolina form. Both now are extinct. See Frank M. Chapman, Handbook of Birds of Eastern North America (New York: Dover Publications, 1966), 390-391.


15. J. C. Fremont, Report of the Exploring Expedition to the Rocky Mountains in the Year 1842, and to Oregon and North California in the Years 1843-44 (Washington: Gales and Seaton, 1845), 28th Cong., 2d sess., 8, Doc. 174, pp. 81-98, Ser. Doc. 161. John Torrey (1796-1873) pursued investigations in several sciences but was most prominent as a botanist.


17. Barry, Beginning of the West, 785-84. As an aid in identifying locations, occasionally I have used the names of Kansas cities and counties before they were actually established.
positions and elevations, but they also were charged with observing the geology, natives, plants, and animals of the region and collecting representative specimens. They crossed Kansas on the Santa Fe Trail to Bent's Fort. Plants collected by the expedition were submitted to John Torrey who prepared a nineteen-page report incorporating information on many Kansas specimens. Another trip in much the same area in 1846 was made by A. Wisselius, M. D., from Germany, who on his own volition accompanied a trading party from Independence, Missouri, to Santa Fe. He observed animals and geological features and collected plants. Detained in Santa Fe by the Mexican War, he was able to get back to the United States only by signing on as physician with a returning military column. His memoir of the trip included some geological observations of Kansas and a botanical appendix, prepared by George Engelmann of St. Louis, listing a number of specimens collected in Kansas. The third trip was made a year earlier by John LeConte, a young physician who visited the West several times and became a noted entomologist. LeConte took the classic route to the Rockies along the Platte River. He then went south to the Arkansas River, and returned eastward on the Santa Fe Trail. During this trip he attempted to collect replacements for some of Thomas Say's specimens which had deteriorated. In this he was successful. He also obtained many other insects, particularly Coleoptera (beetles), which he described in the major scientific journals.

On March 2, 1853, Congress authorized a survey to determine the “most practical and economical” railroad route to the Pacific Coast. Although the survey was placed under a separate Bureau of Explorations and Surveys, much of the work was done under the direction of the Corps of Topographical Engineers, which had been an important factor in exploring the trans-Mississippi West after the corps' reorganization by Col. John James Abert in 1838.

Of the several surveys launched, only the Thirty-eighth and Thirty-ninth Parallel Expedition went through Kansas. That party under Capt. John W. Gunnison left Fort Leavenworth on June 23, 1853, and included Dr. James Schiel, geologist, and Frederick Creutzfeldt, a botanist. At Bull Creek where the Santa Fe Trail and the original Oregon Trail separated, the party split; one group took the Kansas-Smoky Hill River route and the other followed the Santa Fe Trail. Near the mouth of the Saline River the northern party cut southward to the Arkansas River where they rejoined the others. Later, in Utah, Gunnison and Creutzfeldt were killed by Indians and Lt. E. G. Beckwith took command. His report contained general descriptions of the plants, soil, rock formations, and animals encountered in Kansas. Schiel's accompanying report on geology described the limestone strata of Kansas and listed fossils collected, including several from Kansas formations. A report by

18. W. H. Emory, Notes of a Military Reconnaissance [sic] from Fort Leavenworth, in Missouri, to San Diego, in California (Washington: Wendell and Van Bemmelen, 1848) 90th Cong. 1st sess., H. Ex. Doc. 41, appendix 2, pp. 135-58, Ser. Doc. 512. Lt. J. W. Abert submitted a subsidiary report on natural history and gave it to Emory. His plants, mostly from Kansas, also were sent to Torrey who identified them in a nine-page listing. See Emory, Notes of a Military Reconnaissance [sic], 406.14.

19. A. Wisselius, Memoir of a Tour to Northern Mexico...1846 and 1847 (Washington: Tippin and Streeper, 1849), 30th Cong. 1st sess., S. Misc. Doc. 26, pp. 87-115, Ser. Doc. 511. Wisselius had met George Engelmann, leading botanist in the western part of the country, while practicing medicine in the St. Louis area. John Torrey reviewed Engelmann's report.


John Torrey and Asa Gray, another botanist, on the plants collected by Creutzfeldt listed many species found between Westport, Missouri, and the upper Arkansas River valley.  

The Corps of Topographical Engineers continued its surveys in the western states but did little further work in Kansas. Private collectors continued to explore the eastern parts of what became Kansas. For example, J. Soule Bowman left the Kansas City area on May 20, 1853, went up the Kansas River to the Pottawatomi Baptist Mission (Topeka), then north to Fort Kearney, Nebraska, and on west. He was reported to have made extensive collections of fish and reptiles. Another private explorer, Dr. Philo R. Hoy of Wisconsin, collected many species of birds, reptiles, and fish in western Missouri and eastern Kansas in the spring of 1854, including a number of fish said to be new to science.

The Territorial Period, 1854-1861

Once Kansas was organized as a territory and opened for settlement, a new phase of scientific activity began—the collection and study by residents of the natural objects to be found within the bounds of the territory. Previously such work had been done almost entirely by members of traveling parties whose chief interest was in areas farther west. A number of highly respected scientists had participated and much knowledge of the flora, fauna, and geology had been accumulated, but there had been no effort to obtain specifics about the area which became Kansas Territory. Moreover, Kansas had been treated as an obstacle rather than as a goal so most of the work had been concentrated on or near the three major routes to the West.

The proslavery-free state conflict, as well as meeting the basic needs of survival, prevented the earliest emigrants from devoting much time or energy to collecting natural objects or studying natural history. Some, though, evidenced a serious interest in the native wildflowers and other plants, and there was much discussion of improving agricultural practices and crop species. Even earlier, the Wyandotte Indians had experimented with new crops and techniques, and the Jesuit missionaries at St. Marys had introduced new plants and the latest farm machinery. By late 1856 the political situation had quieted sufficiently that residents interested in natural history could travel or explore without much thought of marauding raiders. They could begin to collect unusual specimens, some of which were of sufficient interest to draw the attention of eastern scientists. For example, M. Burke of Topeka collected a large number of species of Coleoptera which were used in an 1859 publication by John LeConte, and Prof. Edward Daniels found a fossil shell in Topeka which was determined by a distinguished eastern conchologist to be a new species.

Possibly the most active group of collectors in the mid-1850s were Fort Riley military personnel, headed by William A. Hammond, an army surgeon. Hammond, who had received a medical degree in New York City


26. Isaac Lea, "Descriptions of Seven New Species...", *Proceedings, Academy of Natural Sciences of Philadelphia* [hereafter cited as *Proceedings*] (1858), 139.
and interned in Philadelphia, had developed a strong interest in natural history and had become acquainted with several Philadelphia scientists. He had met Spencer F. Baird, the Smithsonian Institution's newly appointed secretary, who about 1850 initiated a major effort to build up the scientific collections. Baird encouraged Hammond and other military officers to collect specimens for him, especially when assigned to posts in unsettled parts of the West.

As soon as he reached Fort Riley in 1854, Hammond began to collect birds, insects, plants and other items, and encouraged and trained others, both military and civilians, to help him. In 1855 he discovered an enlisted man, John Xantus, a Hungarian with a law degree and some training in natural history, who proved to be an enthusiastic and able collector. Hammond and Xantus shipped collections to the Smithsonian and to the Academy of Natural Sciences, of which Hammond was a member and which granted Xantus membership in 1856. Their partnership lasted only two years as Hammond was transferred from Fort Riley in December 1856. Before leaving he helped arrange a transfer for Xantus to Fort Tejon, California, where he became one of the pioneer natural history collectors in the Tehachapi Mountains of southern California.

Scientific reports published in the late 1850s provide some idea of the quality and extent of the collections made by Hammond and his assistants. Among the sources of material listed by John LeConte in his work on the Coleoptera of Kansas and nearby areas were a large collection made by Hammond and Xantus at Fort Riley and a collection Hammond obtained on a survey expedition between the fort and Bridge's Pass. In 1856 the Academy of Natural Sciences noted a collection of reptiles from Kansas and Nebraska presented by Hammond, and in 1857 he received a special vote of thanks for the valuable material he had given the academy. Even fifteen years later, worms obtained in Kansas by Hammond were mentioned in a scientific report. Xantus commented on the favorable attitude of Kansas residents toward these pursuits, saying, "I was assisted by everybody, citizens as well as soldiers. They brought me a great number of specimens from all parts around." 22

Although collecting birds, insects, and plants were popular pursuits for some Kansas immigrants, geology was the science of greatest interest to a majority of the newcomers. A major problem encountered when settlers from eastern forested regions moved to the nearly treeless plains was a source of fuel; hence, they were very interested in the possibility of easily available deposits of coal. They also wanted to know what other useful minerals and rocks might be found, particularly building stone, salt, gypsum, and of course, the metals, especially the precious ones. This interest was reflected in the territorial legislature's recognition, as early as 1855, of the need for a geological survey; this was endorsed by Gov. John W. Geary in his opening message to the legislature of 1857. Although the state geological survey was not authorized until after statehood, geological concerns received much attention during territorial days.

Geological knowledge had advanced sufficiently to relate the rocks of certain geological ages to the presence of coal and other minerals. Thus, as the name indicates, rocks of the Carboniferous Period were thought to indicate the possible presence of coal and frequently were referred to as "the coal measures." 23 Also, it had long been accepted that fossil evidence could be used to determine the relative age of rock strata and to identify the same strata in outcrops at various places.

A dozen years before detailed geological work began in Kansas, Missouri established its geological survey headed by George C. Swallow whose assistants included F. B. Meek, Frederick Hawn, and B. F. Shumard. These men played a role in the early geological work in Kansas by gathering a considerable amount of data for western Missouri which also was applicable to eastern Kansas. For example, it seemed certain that the Carboniferous strata which underlay portions of western Missouri extended into bordering Kansas.

On August 26, 1854, John Calhoun was appointed surveyor-general of Kansas and Nebraska, responsible

29. LeConte, Coleoptera of Kansas and Eastern New Mexico, vi.
30. Proceedings (1856), 228, and (1857), 183.
34. Geologists chart time in three major eras: Cenozoic, the most recent 70 million years; Mesozoic, the previous 170 million years; Paleozoic, roughly the 400 million years before that. Prior to the Paleozoic were the Pre-Cambrian ages which go back three or more billion years to the time of the earth's formation. The Mesozoic Era is composed of three periods, the Cretaceous, Jurassic, and Triassic, in order from the most recent to the earliest. The Permian period, just before the Triassic, was the last period of the Paleozoic Era and was preceded by the Carboniferous period.
for setting the territories' physical boundaries. Calhoun appointed Frederick Hawn his deputy and instructed his staff to make notes and observations on geology while conducting their line surveys. Hawn, a civil engineer with a strong interest in geology, devoted much attention to that subject and assiduously collected fossils. Those he thought to be from the Cretaceous period he sent to F. B. Meek, then in Albany, New York, and those he supposed were from Carboniferous formations he sent to Swallow in Columbia, Missouri.55

Some material Hawn sent to Meek in the summer of 1857 brought about a major geological discovery and a celebrated controversy. Meek, to his great surprise, found fossils in this collection which appeared to be identical to fossils from rocks of the Permian Age found in Great Britain and Russia. This was a startling discovery as nothing from that period had been found previously in North America. On September 3, 1857, he wrote Hawn of his discovery and asked for further specimens including any sent to Swallow that had not been firmly identified as Carboniferous. In January 1858 he discussed his discovery with Spencer F. Baird and others at the Smithsonian, but he did not announce his findings to any of the recognized scientific societies or publish them until March 2, 1858, when he read a paper at a meeting of the Albany Institute.56

Meanwhile Hawn and Swallow had communicated and it appears that Swallow had identified some Permian fossils in Hawn's material, probably after being alerted by Hawn to their possible existence. Swallow did not wait to learn what Meek was doing but made an immediate announcement by letter to J. D. Dana of the American Journal of Science and Arts on February 16 and one to B. F. Shumard, president of the Academy of Sciences of St. Louis, on February 18. In the latter, read at the meeting of the academy on February 22, Swallow said he had examined a small collection of Kansas fossils and "can have no doubt that the rocks are Permian ... as several species are identical with Permian species of England and Russia."57 He closed by saying that he took great pleasure in announcing Hawn's important discovery, but he made no mention of F. B. Meek.

When Meek learned that Swallow had announced the discovery before he had done so and without mentioning him, he was understandably irate and made that evident in his Albany Institute paper. Swallow, whose motives are unclear, almost immediately admitted that Meek had first identified the fossils' Permian nature and passed the matter off as a misunderstanding.58 Meek remained unconvinced that he had not been deliberately undercut by Swallow and was still sensitive on the subject ten years later.

The discovery of Permian formations in Kansas was of great scientific interest and also was considered to indicate that sizable deposits of salt and gypsum might be found. Already traces had been detected but their quantity was unknown. The attention of the nation's geologists was directed to this area by the Permian discovery. Swallow and Hawn prepared a paper on "The Rocks of Kansas." Read before the Academy of Sciences of St. Louis in February 1858, it was possibly the first scientific paper solely on a Kansas subject.59 Swallow also prepared a geological map of the eastern and central parts of the territory based on their observations.

Meek, too, was sufficiently interested in Kansas rocks to make a personal visit to the territory. He was accompanied by Ferdinand V. Hayden, M.D. (1829-1887), a geologist and western explorer, with whom Meek earlier had visited the Dakota Badlands. They traveled on horseback, accompanied by a "camping party," over a good part of the central and northeastern sections of Kansas. Their findings were published in a number of papers which presented profiles, or sections of the rock strata of Kansas, and attempted to correlate them with the strata of surrounding areas, particularly Nebraska where Hayden had previously worked and New Mexico where there were rocks with the same Permian fossils. They also collected a number of fossil leaves similar to some Hayden had collected previously in Nebraska; that kind of fossil became increasingly important in sorting out and dating rock strata and relating them to geological formations elsewhere. Although they went no farther than what now is the center of the state, they helped to refute the "great American desert" theory by observing that although they expected to find the land west of Fort Riley comparatively sterile, they found it a luxuriant prairie alive with buffalo, and they learned that the same condition prevailed even farther west. They concluded that "the belt of unproductive lands between the rich country on the east, and the eastern base of the Rocky Mountains on the west, is much narrower than is generally supposed; and even this so-called desert country is known to possess a good

As for mineral resources, they confirmed the existence of some coal, much limestone suitable for building, and inexhaustible beds of gypsum. They speculated on the existence of iron in the Smoky Hill area and gold in the West.

Study of Kansas geology and the collection of geological specimens continued until the outbreak of the Civil War. In 1858, while returning from the Southwest along the Santa Fe Trail, Dr. John S. Newberry, a physician and geologist serving as chief scientist with the Joseph C. Ives survey party, studied the strata of Kansas and collected many fossils. His report described in some detail the formations of the southwestern, as well as the central and northeastern parts of the state, and his list of fossils included a number from Kansas, among them several fossil plants. He expressed the opinion that although the soil in the western reaches was good enough to support a mat of nutritious buffalo grass, it did not get enough rain to raise crops, except in the Arkansas River bottomlands.

Hayden, Meek, Swallow, and others published additional articles on the geology of Kansas and nearby areas in the late 1850s. Although there was much discussion and some controversy over the nature and age of certain formations, a basic outline of the state's

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geological history was generally agreed upon. Further refinement and detailed study of specific areas had to await the return of peace in the mid-1860s.

There is other evidence that the people of Kansas recognized the value of science in the 1850s. The Herald of Freedom in Lawrence called attention to the value of scientific endeavors as early as December 1856, and W. F. M. Arny proposed setting up an extensive "cabinet," or collection, of Kansas natural history, including plants, animals, soils, and minerals. Douglas County had an active Agriculture and Mechanical Society in the late 1850s, and in 1859 a state Historical and Scientific Society was chartered. The latter set up standing committees for geology, botany, zoology, meteorology, and mineralogy at its first annual meeting in February 1859. The members of those committees, and of the society in general, were mostly politicians, businessmen and ministers, few of whom were acquainted with one of the sciences. At the second annual meeting in January 1860 there were no reports from the standing committees. The members of all the committees supposed themselves better acquainted with political science than with any of the obscure sciences." Nothing more was heard of the society, presumably it was a casualty of the upcoming war.

The attempt to establish a scientific society in Kansas unquestionably was premature, but it reflects the growing national interest in science in the late 1850s and recognition of its practical applications to mechanics, agriculture, and other pursuits. Few persons, other than college professors, devoted their full time to science, but some began to adopt a professional approach to their scientific pursuits. Professional associations, which began in the 1840s, and scientific journals, which began even earlier, proliferated and began to specialize. In Kansas, although science was looked to as a source of useful knowledge, there were few residents with a serious interest or training in science. This situation began to change as schools were organized and a need for instruction in scientific subjects was created.

Elementary schools appeared in Kansas as the territory opened for settlement in 1854. The first teachers generally had some experience or interest in teaching, but many had little or no schooling beyond the elementary level. As border warfare died down and emigration increased, elementary education expanded rapidly and a demand arose for secondary schools and even college training. In the period from 1855 to 1860 nearly thirty "colleges and universities" were chartered in Kansas. Many existed only on paper, and the few to actually open their doors provided, at most, high school training until the early 1860s. Nevertheless, these institutions provided teaching opportunities for persons with college training, including some with an interest or background in science.

Most of the colleges, universities, or institutes that actually began operation were sponsored by church organizations. Baker University in Baldwin, Methodist sponsored, began classes on November 22, 1858; Highland University in Highland also opened that fall under Presbyterian auspices. They were followed about a year later by Bluemont Central College in Manhattan, another Methodist institution, and St. Benedict's College, a Catholic school, in Atchison. Leavenworth also had a pioneer institution, the Male and Female High School which started in the spring of 1859 and was granted a charter as Leavenworth College in 1860.

The little existing information about teaching in territorial Kansas indicates that science was not entirely neglected. Baker University appointed R. B. Cunningham as professor of mathematics in April 1859, and is reported to have created a medical department in the spring of 1860. The act incorporating Bluemont College envisioned "an agricultural department, with separate professors, to test soils, experiment in the raising of crops...[and] bring out...the agricultural advantages of Kansas...." However, the school in its early years was devoted mostly to teaching elementary subjects to local children. Isaac T. Goodnow, who had taught natural science in an academy in Rhode Island, gave

42. Even European geologists took part in the discussion, notably Jules Marcou, a Swiss geologist who served with the Thirty-fifth Parallel railroad survey and later visited Nebraska, and possibly Kansas, with an Italian scientist, Gappelini.
44. Lawrence Republican, January 26, 1860. See also issues of February 10 and 24, 1859, and James C. Malin, "Notes on the Writing of the General Histories of Kansas," Kansas Historical Quarterly 21 (Spring 1959):343-47.
47. Both schools can claim to have been chartered first because Baker had two charters issued only a few days apart while Highland's was issued between them. See Arvin John Parish, History of Highland Community College (Troy, Kans.: Trojan Graphics, 1983), 11.
49. Catalogue of Baker University, for Collegiate Year 1862-63, Baldwin City, Kansas (Lawrence: Kansas Tribune, 1863), 14-17. The "medical department" was said to have been in Leavenworth but no further mention of it has been found.
classes in algebra and astronomy in 1861, but spent most of his time on other tasks, principally raising money to keep Bluemont open.34 St. Benedict's College in Atchison opened on October 12, 1859, with fifteen students. Geography, algebra, and astronomy were in the curriculum, but most of the students were in the elementary school even after a rapid rise in enrollment justified the erection of a new building in 1861.35

Statehood and Civil War, 1861-1865

Kansas became the thirty-fourth state in January 1861 and less than three months later war broke out. Life in the new state was disrupted by the Civil War more severely than might be expected in view of its distance from the scenes of the major battles and political events. A high percentage of the male population entered military service. Military action threatened on the state's borders, and the revival of border warfare culminated in Quantrill's raid on Lawrence. Furthermore, the effects of the serious drought of 1860, which forced many settlers to leave the state, still were felt when the war began. Under these conditions it is remarkable that education made any progress, but new private and public schools and colleges were organized and many of the old ones enjoyed increased attendance. In part, this resulted from the settlement of new areas and an increase in population; the U.S. census counted only 107,206 Kansans in 1860 while the first state agricultural census in 1865 reported 140,179.37

Although there was little place for scientific activity in Kansas during the war years, the existing catalogs, reports, and historical notes show that science was included in many college and school plans and curricula and that, as teaching opportunities improved, persons with a special interest or a modicum of training in science were attracted to the state. These first teachers were more likely schooled in theology, medicine, or law than in natural science but they had the breadth of interest and habits of observation which led them to examine their natural surroundings and to keep abreast of developments in one or more of the sciences. Many became very capable instructors and, of more importance, had the ability to inspire students. As a result, Kansas in the early 1870s, only twenty years after it was opened for settlement, began to produce college graduates who in time earned national or even international recognition as scientists.

At Baker University the first published course of study, issued for the 1861-1862 school year, set up three departments: a preparatory school, a four-year college department, and a three-year scientific department.38 At that time no college-level students were enrolled, but the next year five students were in the freshman class. The subjects for the four-year college, or classical, curriculum included mathematics through calculus, physiology, zoology, botany, chemistry, mechanics, physical geography, geology, mineralogy, and meteorology. The scientific curriculum, described as being for those who wished "to prepare themselves for the active duties of life," eliminated some language courses but retained the sciences except for calculus and mechanics. Joseph G. Snively became a member of the faculty in November 1862 and undoubtedly taught whatever science was offered. In April 1863 he moved to the Kansas State Agricultural College (KSAC) in Manhattan, and the Rev. James H. Carruth (1807-1896), a graduate of Yale University, was appointed professor of natural science. For the next three years Carruth taught all science courses. By this time Baker had acquired some scientific equipment, including a telescope and what probably was the first microscope in Kansas.39 Professor Carruth also may have been responsible for the small collection of geological and mineralogical specimens that served as the Baker "cabinet."

It might be well to note that in a frontier area the scientific endeavor most easily undertaken was the assemblage of a "cabinet" of birds, insects, plants, rocks, fossils, or other natural forms to serve as a teaching aid and to demonstrate the depth and range of the scientific interests of the professor and the school. These efforts required little in the way of equipment or supplies, and every college, and even some high schools, in Kansas began a collection of local specimens.

Broader efforts to collect and identify all the species of a class of natural objects to be found in Kansas were


52. Frank W. Blackmar, ed., Kansas (Chicago: Standard Publishing Co., 1912), 1:506. Blackmar questions the accuracy of these and other early attempts to count Kansas residents.

53. Osman Grant Markham, ed., Alumnae Record of Baker University (Baldwin City: April 1917), xvi. Setting up both a college or classical course and a scientific course was standard practice in this period. The scientific course generally was designed for students who wanted practical training (engineering, business, etc.) while the classical course was aimed at the student who planned to go into the ministry or teach.

54. Catalogue of Baker University, 1862-63, 9-13, 17. In judging the slow development of science teaching in Kansas it should be noted that as late as 1850 no college in the United States had a laboratory and scientific experimentation was not an accepted function at most schools. James C. Carey, Kansas State University, the Quest for Identity (Lawrence: Regents Press of Kansas, 1977), 22.
undertaken in the mid-1860s. For some classes such as insects or plants with tremendous numbers of species, this was a long-term and generally collaborative project. The Reverend Carruth was the first to attempt to collect and identify the plants of Kansas and may be considered the first Kansas botanist.

Leavenworth College in its 1861-1862 catalog listed a preparatory course and a college course. The preparatory students had only algebra and geography which might be called scientific subjects, but the college course included practically the same sciences as the college course at Baker. How many actually were taught is unknown, but there was a professor of mathematics and physical science, L. A. Stone, A. M., and what was described as a “considerable commencement” on scientific apparatus and a natural history collection. By 1864 Leavenworth College had eighty students and claimed to have the “best school apparatus in the West, including a microscope and telescope of remarkable power.”

Possibly the most significant development in the beginnings of science instruction in Kansas resulted from the Morrill Act of 1862. That act donated public lands to endow and support at least one college in every state to teach branches of learning of value to persons engaged in agriculture and the mechanical trades. It was a reaction against the heavily classical curriculum and great emphasis on theory and theology found in most colleges, which many believed did not serve the needs of the farmers and artisans who made up the vast majority of the U.S. population.

Shortly after the Morrill Act was passed, the trustees of Blue Mountain College, then struggling for existence, offered their building, library, apparatus, and one hundred acres to the State of Kansas for use in complying with its provisions. In February 1863 the legislature accepted the land grant provisions of the act and the offer of Blue Mountain. The deed of ownership was conveyed on July 10, 1863; a board of regents for the school, renamed Kansas State Agricultural College, was soon appointed. The Rev. Joseph Denison was elected president; Joseph G. Schnebly was appointed professor of mathematics and natural science; and the school opened its doors on September 2, 1863.

As with other early Kansas colleges, much of the instruction was at the secondary school level for many years. During the first fall term Professor Schnebly is credited with teaching algebra, geometry, and physiology. Later that year, the 1863-1864 catalog was issued; it outlined a four-year collegiate course leading to an A.B. degree. Requirements included mathematics through analytic geometry and all of the usual sciences. Fourteen freshmen were enrolled, the rest of the school being preparatory and elementary students. In 1864-1865 a three-year agricultural course was added. It was comprised of one year of preparatory work and two of college. Besides an introduction to most of the sciences, it included agricultural subjects such as animal husbandry and agricultural chemistry. A test orchard and timber belt were authorized by the board of regents but were not in place because of lack of funds. Twenty-three students, including eight upperclassmen, were enrolled in the collegiate course. Some apparatus for teaching chemistry and physics was available, but records do not show how many of the listed sciences actually were taught. In 1865, Schnebly took a leave of absence and did not return. Late in December 1865, Benjamin Franklin Mudge (1817-1879), one of the major figures in early Kansas science, was appointed in his place.

Mudge, born in Maine but raised in Massachusetts, graduated from Wesleyan University in Middletown, Connecticut, and then practiced law for about fifteen years. He then moved to Kentucky and worked as a chemist for a coal company. When the Civil War began he came to Kansas because of his strong free-state beliefs. He settled in Wyandotte County and taught school. He also retained an interest in several sciences, especially geology, and collected specimens of various kinds.

In 1863 the legislature established the State Normal School, or teacher-training college, located it in Emporia, and endowed it with public lands expected to provide most, if not all, of its operating funds. Classes began on February 15, 1865, with Lyman F. Kellogg, a recent graduate of Illinois Normal, as principal and sole instructor. Before the year was out, another Illinois Normal graduate, Henry B. Norton, was hired as vice-principal and professor of natural science. Norton had a keen interest in science and was instrumental in introducing a science curricula and arousing student interest.
Church organizations continued to add to the roll of Kansas colleges during the war years. The Episcopal Female Seminary in Topeka opened its first term on June 10, 1861. Although the instruction undoubtedly was at the high school level, botany, mathematics, and natural philosophy (physics) were among the subjects taught the first year. In following years, science received increased emphasis, and by 1865 zoology, chemistry, geology, and physical geography were added to the required subjects. Apparatus was purchased, and a nucleus of a cabinet was formed. Another new school was Wetmore Institute. Opened in Irving under Presbyterian sponsorship in December 1864, it was reported a year later to have a thriving normal department and to possess a good library and scientific apparatus. Other schools opened during the war were Lane University in Lecompton, Western Christian University at Ottumwa, and Hartford Institute in Lincoln County. All provided at least high school instruction and probably held classes in one or more sciences, but specific evidence is lacking.

The public schools also provided pupils with an introduction to science. The list of textbooks recommended by the state superintendent of public instruction in 1863 for use in elementary and secondary schools included books on mathematics, physiology, chemistry, geology, botany, geography, and physics. As early as 1864 the State Teachers' Association's journal carried short articles suggesting the use of examples and principles from the natural sciences in the elementary grades. In 1861 the high school in Lawrence was teaching mathematics, physics and physiology, and Shawnee County high schools had classes in algebra, physiology, and geography. The Leavenworth public high school in 1865 was said to have excellent chemical, physics, and astronomical apparatus and a fair geological cabinet.

Only one area of scientific endeavor, other than education, moved forward during the Civil War. In 1864 the long-sought state geological survey was approved. The exploration of the state's geology by Hawn, Meek, Hayden, and others had not satisfied the settlers' demand for a survey of soils and exploitable minerals or other resources. Public support for a survey intensified in 1863, in part as a result of the efforts of Watson Foster, a chemist and sometime farmer who had come to Kansas in 1860. Foster, a rather mercurial figure frequently involved in controversy, was elected to the legislature in 1863 and probably was behind a bill for a geological survey introduced in February but not passed. Early in the 1864 session a similar bill was

61. Superintendent of Public Instruction, (unnumbered) Report, December 31, 1861 (n.d.), 30. "Natural philosophy," referred to in the superintendents' reports and school catalogues, evolved into what we know today as the study of physics. For clarity this article will refer to this study in today's terms, physics.


Benjamin Franklin Mudge, an important figure in Kansas' scientific community, taught at Kansas State Agricultural College, headed the state's first geological survey, and was a major collector of Kansas fossils.

63. Superintendent of Public Instruction, Fifth Annual Report, December 15, 1865 (1866), 50.
64. This also is true for St. Benedict's College and for Highland University, mentioned earlier.
67. Superintendent of Public Instruction, (unnumbered) Report, December 31, 1861 (n.d.), 28, 30, and Fifth Annual Report, 41. This equipment probably was inherited from Leavenworth College which seems to have been consolidated into the public high school in 1865.
introduced and received favorable action. That same month B. F. Mudge gave a series of three lectures on
geology in Topeka. These were well attended and it was said that Mudge demonstrated a "perfect familiarity
with his subject." When the bill passed, there were
three major candidates for the state geologist position—
Mudge, Foster, and G. C. Swallow. Foster was enmeshed
in political controversy; Swallow was tainted with sup-
pposed sympathy for border ruffians; and Mudge received
the appointment.

The act under which Mudge was appointed gave him
a one-year term starting March 1, 1864, and authorized
him to spend $3,500. With this sum he was expected to
procure the equipment and assistance needed to classify
the rocks and soil of each county, to investigate salt
springs, coal deposits, and the depth and quality of the
soil, and to collect a cabinet of geological specimens.
Mudge immediately appointed four assistants—
Frederick Hawn, G. C. Swallow, Tiffin Sinks, and G. A.
Logan (the latter two Leavenworth physicians)—and
advertised for help from the state's scientific men to
make up for the meager appropriation. He spent much
of the next year personally surveying the settled part of
the state.

Mudge's fifty-six page survey report, after pointing
out that his reconnaissance covered only the eastern
two-thirds of Kansas, discussed the general nature of the
geological formations in that area. Next, he pro-
vided more details concerning the examined forma-
tions, beginning with the coal measures, which covered
twenty-two thousand square miles, and moving forward in
time to recent alluvial deposits. He mentioned a coal
shaft being sunk near Leavenworth and suggested that
in time coal mines would be found throughout the state's
eastern section. A concluding presentation on economic
geology summarized findings on the presence of various
rocks and minerals and the outlook for exploiting them:
coal was plentiful and of good quality but not found
on the surface; gypsum and limestone were widely
available; salt was abundant; building stone was found
at numerous sites; petroleum existed to some extent; but
the metals were practically nonexistent.

In 1865 the legislature again authorized the appoint-
ment of a state geologist. His term was to begin on
March 1, and he was authorized to spend $7,500 to
conduct a geological survey. Although the act did not
so state, it appears that the provisions of the 1864 act
were assumed to extend to the new survey, including the
requirement for a report to the governor. Mudge was not
reappointed. Possibly he felt he could spend his time
more profitably as Wyandotte County's superintendent
of schools. The new state geologist was G. C. Swallow
who continued the previous survey's work with the same
staff. His 198-page report, presented in a letter to the
governor, dated January 8, 1866, reflected the more
adequate appropriation by providing much more detail
than the previous report. Swallow provided a section, or
profile, on the geologic formations from the newest
(Quaternary) to the oldest (Lower Carboniferous, now
known as Mississippian) and analyzed each of the major
systems found. On a subject of great interest to most
of his readers, economic geology, he discussed soils,
the coal deposits which underlay seventeen thousand-
square miles, the extensive deposits of gypsum and salt,
the promising indications of petroleum, and the deposits
of iron, lead, building stone, and fire clay. He also
evaluated timber and water resources, climate, crops,
and even had a few words on fences and railroads. His
part of the report ended with a detailed analysis of the
geology of Miami County. This was followed by Hawn's
reports on the rocks, soil, minerals, and agricultural
prospects of nine other counties, two in the north-
western corner and seven in the east-central part of
Kansas. Dr. Logan provided a sanitation survey that
outlined the state's physical conditions and disease
problems and recommended a sanitary commission to
device a code of sanitation laws, set up a vital records
system, and institute compulsory vaccination. Dr. Sinks
concluded the report with a comparison of temperature
and rainfall records at military posts in Kansas with
similar data from St. Louis and other cities.

Science Education After the War, 1865-1875

The end of the Civil War found Kansas already well
started on the resumption of peacetime activities.
The influx of settlers had accelerated. If the census
figures can be trusted, Kansas more than doubled its
population between 1865 and 1870. The resulting
demand for schools at all levels, and for teachers, led

69. Leavenworth Daily Times, January 28, 1864. For a detailed
review of the origin and legislative approval of the first Kansas
geological survey, see Rex Buchanan, "Science and the Disciples of
Progress: Creation of the First Kansas Geological Survey, 1864," Kan-
70. Laws of the State of Kansas passed at the Fourth Session of the
Legislature (Lawrence: Kansas Daily Tribune, 1864), chapter 69,
125.
72. B. F. Mudge, First Annual Report on the Geology of Kansas
(Lawrence: John Speer, 1866). Internal evidence indicates this report
was not prepared as published until late in 1865.
73. Laws of the State of Kansas passed at the Fifth Session of the
Legislature (Topeka: S. D. MacDonald and Co., 1865), chapter 40,
p. 80.
Kansas (Lawrence: John Speer, 1866).
to an increase in science courses and interested students and helped attract well educated teachers to the state. The economic boom extended into the 1870s but suffered a reversal before the middle of the decade. The nationwide economic depression reached Kansas about 1874 and its effect was intensified by the grasshopper invasion of that year and by a period of unfavorable weather. Farming, the state's economic base, suffered severely, and the colleges, almost without exception, were financially strapped. Some closed, and in the others many programs were curtailed, including courses requiring scientific laboratory facilities and equipment. Even so, the decade from 1865 to 1875 saw a considerable expansion and improvement in science education.

In the spring of 1866 Baker University granted the first college degrees to be issued in Kansas. Training in science continued much as before although mathematics, zoology, and botany now were covered in the first two years while chemistry, astronomy, and geology were reserved for the last two years. A new mathematics professor, Bradford S. Potter, possibly was the first Ph. D. to teach in Kansas. James H. Carruth resigned in April 1866. His replacement stayed only a year and was followed by Jacob M. Whitman, a medical doctor from Pennsylvania who had much teaching experience, including nine years at the Agriculture College of Pennsylvania. Whitman brought his personal collection of fossils, minerals, invertebrates and plants, said to be worth $10,000.75

In 1867 Baker offered a special course in chemistry for students who wished to prepare for the study of medicine or for a clerkship in a druggist.76 This may have been the first course in pharmacy taught in Kansas. A new subject, entomology, was introduced into both the classical and scientific courses in 1867-1868. Two more degrees were granted in 1869, but there were no more graduates until 1872, as Baker fell on hard times about 1870. During the next two or three years attendance declined, some of the faculty were dismissed, and equipment and, possibly, even part of the cabinet was

75. Annual Catalogue of Baker University, 1865-66, Baldwin City, Kansas (Lawrence: Speer and Russ, 1866), 19-22. Markham, Alumni Record of Baker University, xxi. The Whitman collection and the one B. F. Mudge brought to KSAC were the first scientific collections of any consequence in Kansas.

76. Markham, Alumni Record of Baker University, xxi.

In 1867, Baker University offered what may have been the first class in pharmacy taught in Kansas. By 1895, the year in which this KU pharmacy class posed for a group portrait, that subject, as well as other scientific based classes, was widely taught throughout the state.
sold to satisfy a judgment against the school. Baker may have been able to remain open only because J. G. Schnebly and others provided some instruction as unpaid volunteers. Matters improved in 1872, at least in the natural history field, when Martin Van Buren Knox received a degree and shortly thereafter joined the faculty. He was interested in all branches of natural science and was said to talk science night and day. An enthusiastic but untrained collector, he received much encouragement and advice from F. H. Snow of Kansas State University (later the University of Kansas). His students in botany, zoology, geology, and entomology soon actively pursued specimens and helped to rebuild the school's cabinet. By 1874 it contained twenty-six hundred geological items, many plants and insects, and two hundred stuffed birds and mammals. Knox himself hunted birds in the Kansas River, searched for fossils in the Solomon River valley, made collecting trips to Colorado, and actively participated in the Kansas Academy of Science.

The State Normal School in Emporia developed rapidly in response to the postwar demand for teachers and, with Henry B. Norton on the staff, soon offered instruction in science. In 1866, while the school still was housed in rented space, the board of visitors observed classes in mathematics, geography, and geology. The normal school's first building, completed the following year, had some facilities for scientific study. A class in botany was taught that year, and the offerings in science continued to expand. Norton, aided by some of his students, collected specimens for a school cabinet to be set up as soon as display cases could be obtained. In 1868 available scientific apparatus was estimated to be worth $150, but Norton got additional funds and in 1870 nearly two hundred dollars was spent on supplies and equipment. At this time the course of study included astronomy, botany, geology, zoology, chemistry, and physics. Most students worked toward teaching certificates rather than college degrees, but included some science in their programs.

Professor Norton resigned in 1870 and was replaced by R. B. Dilworth, a graduate of Princeton. With the growth in enrollment, the original building became inadequate and a new building was funded in 1872. Dedicated in June 1874, it contained two laboratories, supplied with water, gas and steam, and a small room designated to house the natural science collections. New equipment was ordered including microscopes, magnets, an air pump, an electrical machine, and meteorological instruments. In 1875 Dilworth resigned and Norton was induced to return as professor of natural science. During the year, attendance reached 170, and in June three degrees were granted. Norton, helped by an adjunct professor, taught zoology, chemistry, physics, geology, botany, and geography in 1874-1875. He endeavored to build up the cabinet, and at his suggestion the science students organized the "Agassiz Club" to help collect and prepare specimens. Members also wrote and discussed papers on scientific topics at a public meeting held once each term.

To meet an increasing demand for teachers, the legislature authorized additional state normal schools. The first opened in Leavenworth in 1870. In 1872 a small sum was appropriated for a normal school for black teachers in Quindaro, and in 1874 a normal was opened in Concordia. Many legislators, educators, and citizens at large, recognized the need for these schools but believed that they, and even the state's two major schools, should operate exclusively on funds derived from student fees and from the public lands with which some of the schools had been endowed. During the hard times of the mid-1870s this theory became practice, with disastrous results for the normal school system.

The Leavenworth Normal School began operations in September 1870 on the upper floor of the Morris School building. The normal department offered a two-year elementary course, which led to a high school diploma, and a three-year advanced course, which led to some form of college degree. The elementary course included algebra, geography, physiology, and physics. The advanced course added chemistry, zoology, astronomy, and more mathematics. Most of the students in the early 1870s were enrolled in the elementary course, but there were as many as eight in the advanced course, three of whom graduated in 1873.

81. Superintendent of Public Instruction, Twelfth Annual Report, December 3, 1872 (1872), 185, 188. See also [Albert R. Taylor], A History of the State Normal School of Kansas, for the First Twenty-Five Years (Emporia: 1889), 45, 50-51.
82. Taylor, History of the State Normal School, 81; Superintendent of Public Instruction, Fourteenth Annual Report, December 31, 1874 (1874), 155-56. These clubs were named for Louis Agassiz, noted Swiss geologist and zoologist who taught at Harvard University.
84. Superintendent of Public Instruction, Twelfth Annual Report, 202-3.
John Wherrell, high school principal and later
president of the school, undoubtedly taught most of the
science and mathematics courses. He had taught in
Kansas for several years and was one of the early
members of the Kansas Academy of Science.64 Leaven-
worth Normal boasted a telescope, compound micro-
scope, electrical machine and air pump, and had an
experimental laboratory fitted up at a cost of $400. A
cabinet of geological and other specimens was in place
in 1872 and was augmented in later years.65

The Quindaro Normal School was short-lived and
ever received adequate funding or facilities. The Con-
cordia Normal opened in 1874 with an enrollment of
sixty-six and a course of study including botany, phys-
ology, physics, and geography. J. S. Shearer was the
professor of natural science and methods of teaching.67
In 1876 the legislature cut off funds for all normal
schools and declared that the Leavenworth and Concordia
institutions no longer should be considered state
schools. Emporia retained its state school status but was
forced to limp along for several years largely on student
fees.68

The teaching of science at KSAC received a tremen-
dous boost when B. F. Mudge, who had earlier carried
out the first Kansas geological survey, began work there
as professor of natural science and higher mathematics
on January 1, 1866. Mudge was responsible for all
mathematics and science, but within a few months
Jeremiah Evarts Platt took over some of the mathe-
matics.69 In 1867 Mudge gave a course in "Insects
Injurious to Vegetation" which some consider to be
the first course in economic entomology taught in the
United States.70 What other subjects he taught cannot
be determined precisely, but the five seniors who in
June 1867 received the first degrees granted by KSAC
were credited with studying physiology, botany, zoology,
physics, chemistry, mineralogy, and geology, in addition
to mathematics. Shortly after joining the faculty Mudge
agreed to donate a cabinet of mineral and geological
specimens to the school if a suitable display was pro-
vided. Funds for a case and to pay shipping charges were
obtained in 1867, and the next year the school's collec-
tions were estimated to be worth $2,000, which was more
than any other Kansas school reported.64

In 1867 KSAC had two courses of study, a four-year
academic, or classical, course modeled on those of
eastern colleges and a three-year agricultural, or sci-
entific, course. The latter stressed agricultural subjects
including soil analysis and tillage, the care and breeding
of farm animals, fruit growing, injurious insects, and
farm economy and buildings.69 In April 1868, John S.
Hougham, a graduate of Wabash College in Indiana
and a specialist in agricultural chemistry, became pro-
fessor of agricultural science. He taught physics and
chemistry during the late 1860s and supervised the
purchase of some good laboratory equipment, but the
lack of facilities and money limited the practical work
undertaken in the agricultural subjects.69

Meanwhile, Mudge taught higher mathematics and
other sciences. The agricultural course emphasized
agriculture but also exposed the students to much basic
science. During their second and third years, students
went on field excursions with the professor of agricul-
ture or of natural science. Most of the approximately
one hundred seventy students were in the preparatory
and normal departments as no degrees were granted
between 1867 and 1871. During this period KSAC took
pride in its success in preparing teachers, announcing
in 1869 that ninety-five had received certificates to
date.64

During the late 1860s the KSAC board of regents set
up the first systematic means of disseminating useful
scientific information to Kansas farmers. The president
and faculty were asked to visit the state's most populous
sections to lecture on agricultural subjects and to discuss
agricultural principles with farmers. The first agribuc-
tural institute was held in Manhattan on November 14,
1868. President Denison talked on the relation of the
college to agricultural interests; Professor Mudge lec-
tured on tree bowers; Professor Hougham discussed
farm economy; and the Rev. Elbridge Galve of the board
provided pointers on fruit tree culture. A week later

85. John W. Wherrell, M.D. (1843-1909), was a native of England
who came to Kansas in 1863, taught school until about 1880, and then
took up medicine.
86. Leavenworth State Normal School of Kansas, 2nd Annual Catalog,
1872.
87. Superintendent of Public Instruction, Fourteenth Annual Re-
port, 169-70.
89. Third Annual Catalogue of the Officers and Students of the Kansas
State Agricultural College, 1866-7 (1867). 5. Platt must have been very
versatile as he was professor of mathematics, vocal music, and
calisthenics. See Fourth Annual Catalogue...1868-9 (Manhattan:
Standard Office, 1869), 5.
90. Geo. A. Dean, "The Contribution of Kansas to the Science of
91. Superintendent of Public Instruction, Sixth Annual Report,
46-49, 51, and Seventh Annual Report, 27, and Eighth Annual Report,
December 20, 1868 (1869), 65-84.
92. Report of the [United States] Commissioner of Agriculture for the
93. Julius Terrass Willard, History of the Kansas State College of
Agriculture and Applied Science (Manhattan: Kansas State College Press,
1940), 21, 462.
94. Report of the Commissioner of Agriculture for the Year 1869 (1870),
454-55.
another institute was held at Wabaunsee, and in January 1869 Manhattan hosted a third. The series' popularity made it an annual winter event in Manhattan for a number of years.55

During the early 1870s KSAC continued to lead in providing good science instruction. Enrollment remained in the 150-200 range, the college contingent numbered thirty-four in 1871, and college degrees were granted every year from 1870-1871 forward. The work in agriculture was increased in 1871 by hiring the Reverend Gale as professor of horticulture and Fred E. Miller as professor of practical agriculture and superintendent of the school farm. Most notable of the lectures given by outside experts was a series on economic entomology by Charles V. Riley of Missouri University.

In 1872 the long-felt need for a professor of veterinary medicine was met by hiring Dr. H. J. Detmers, born and educated in Germany. When J. S. Hougham resigned to go to Purdue University, Detmers' daughter, Jennie, began teaching chemistry and German. Professor Miller, who had 415 acres of farmland to work with, expanded the experimental program by testing new crops, checking new farm machinery, and trying out various methods of soil preparation, fertilization, and seed selection. The Reverend Gale, in charge of a large orchard and forty thousand other trees, sought to improve forest and orchard culture, experimented with vineyards, and developed shelter belts.56

Despite these favorable developments, controversy continued and KSAC experienced significant changes. One factor, the restriction of funding in the mid-1870s, was a common problem for all Kansas schools, state or private. KSAC's unique problem was the accusation that it was not fulfilling the purpose of its organic act, that it was teaching too much ancient language and theoretical science and not enough practical farming and mechanics. This dispute and its outcome had sufficient impact on the development of science in Kansas to warrant a separate discussion in this essay.

Two major colleges appeared in Kansas within a year after the end of the war, and both played an important role in science education. The first was Lincoln College, sponsored by the Congregational Church, which opened in Topeka on January 3, 1866. Although two courses, a three-year preparatory and a four-year ladies' course, were outlined in the catalog, all students were enrolled in the preparatory department during the first two terms. The preparatory course included mathematics but no science; the ladies' course listed physical geography, physics, astronomy, geology, chemistry, and botany. George H. Collier taught mathematics and physics while Edward F. Hobart was acting professor of chemistry and natural science. A cabinet of minerals from the East was on hand, and a choice lot of instruments had been promised.57

Collier went to Oregon State in August 1866, leaving Hobart as the science staff for the next year. The catalog issued that fall added a four-year collegiate course which included mathematics through calculus and added chemistry to the science subjects of the ladies' course. Although there were no students qualified to be freshmen, two upperclassmen and eighty-seven preparatory students were enrolled. For the spring term the Rev. John D. Parker, a graduate of Michigan University and the Chicago Theological Seminary, was hired as professor of natural science and higher mathematics.58 Parker became one of the most prominent and enthusiastic supporters of scientific education and organizations in Kansas.

The next year, 1867-1868, was significant for the school. Its name was changed to Washburn College, five freshmen were enrolled, and the first college degree was granted. The majority of students, fifty-five out of sixty-two, were enrolled in the preparatory course; roughly that proportion prevailed for the next several years. Two collegiate courses were offered, scientific and classical. Science requirements were increased in all courses, mostly by adding physiology and zoology. While not all subjects listed in the catalog were taught every year, there is evidence that Professor Parker taught zoology, botany, geology, physical geography, and astronomy in the 1866-1869 period.59 Parker resigned in the summer of 1869 but remained in Kansas and continued to support scientific activities. He was replaced by George C. Merrill, M.A., from Massachusetts.

Washburn College continued to place an emphasis on science in the early 1870s. Botany, chemistry, zoology, physiology, and astronomy were required. Of the fifty-

95. Alfred Charles True, A History of Agricultural Extension Work in the United States, 1785-1923 (reprinted. New York: Arno Press, 1969), 9-10. All of the state schools sought to help justify their existence by passing useful scientific information to the public. Public lectures by faculty members began early in the existence of both KSAC and KU.
five students enrolled in 1871-1872, nine were in a collegiate course. Professor Merrill sought to re-build the school's cabinet which appears to have been depleted, probably when Parker removed his private collection. In 1872 Merrill accompanied Mudge on a collecting trip through north-central and northwestern Kansas and was credited with discovering several fine specimens, including one species, *Empo merrilli*, which Edward D. Cope, curator for the Academy of Natural Sciences of Philadelphia, named for him. In 1874 Washburn College moved into a new building, later known as Science Hall. This had several rooms designed as laboratories but lack of money for interior finishing and purchase of equipment limited usefulness until after 1875.

The other major Kansas school established in 1866 was today's University of Kansas which, after false starts and considerable wrangling over location, opened in Lawrence in September with a faculty of three. Francis H. Snow was elected professor of mathematics and natural science. Snow, a graduate of Williams College in Massachusetts had taken several science classes but had just received a degree in divinity from Andover Theological Seminary. He considered himself much better qualified to teach ancient languages and *belles lettres* than science and feared his limited scientific training might cause his teaching to be superficial. Fortunately for the development of science in Kansas, he had no opportunity in the first year or two to transfer to a professorship in which he could use his language training, and later he was too interested in science to consider a change.

102. It is not true, as frequently stated, that Snow came to Kansas thinking he would be teaching languages and literature. On August 2, before leaving Massachusetts, he wrote in his diary that he had been elected to "the Professorship of Mathematics and Natural Science in the State University of Kansas." On August 10 and 11 he was in Boston looking at scientific apparatus. See Journal of Frank H. Snow, July 9, 1862, to Aug. 11, 1866, Francis H. Snow. *Journals 1858-66*, ser. 2/6/6, Chancellor's Office, University Archives, University of Kansas.
103. Snow to Jean Appleton Aiken, September 16, November 2, 1886, "Letters to His Fiancee, Jean Appleton Aiken" (typescript), 72, 87, Kansas Collection, Spencer Research Library, University of Kansas.
When the newly elected faculty examined the first students, they found none qualified for college-level instruction. Consequently, the professor of science spent most of his first year teaching preparatory mathematics. During that first fall he brushed up on geology and chemistry, and by the spring of 1867 felt competent to offer a class in chemistry. The new building occupied by the university had a large basement room which Snow fitted up as a chemical laboratory and in May, with some pride, he performed chemistry experiments before his class.104

The fledgling science professor began his lifelong pursuit of collecting natural history specimens, even before the first students arrived. A room on the third floor was set aside as the university cabinet, and Snow spent much of his spare time collecting fossils, plants, and other specimens from as far away as the Missouri River bluffs.105 He also prepared a lecture on how the study of natural science assisted in individual development. When presented in Topeka, it drew only a small crowd, but the Kansas Educational Journal accepted it for publication. The next fall his interest in and study of meteorology led to a lecture and the public observation of a meteor shower. This talk was well received locally,

104. Snow, "Letters to His Fiancée," 75, 92, 98, 123.
105. Ibid., 67-8, 121-22.

One of the first prominent promoters and teachers of science in Kansas was Francis H. Snow, University of Kansas professor.

printed in the local press, and copied by newspapers in Chicago and St. Louis.106

In the fall of 1867 the university enrolled its first two college students and the following year added two more. College enrollment steadily expanded, but for several years a majority of students were in the preparatory department. The first course catalog was published in 1866-1867, and all of the usual sciences of the day were covered. As revised the next year, and used for several years thereafter, the classical course in 1868-1869, leading to a B.A. degree, required mathematics through analytic geometry but only physics, chemistry, geology, and astronomy of the sciences. The scientific course, which led to a B.S. degree, added calculus, zoology, botany, anatomy, mineralogy, and meteorology.107 Obviously, Snow was not required to teach all of these subjects immediately. He taught physics in the fall of 1867, started a class in botany in the spring of 1868, and probably also taught zoology that year. He received some relief in 1868 when William H. Saunders, a Lawrence physician, was hired to teach chemistry, and Gen. John Fraser, who had taught mathematics and astronomy in Pennsylvania, took over as chancellor. Additional help came a year later when Frederic W. Bardwell, an experienced teacher and former employee of the U.S. Naval Observatory, was appointed to the chair in mathematics. From that time forward, Snow concerned himself only with zoology, botany, geology, and meteorology.108

From the beginning, the University of Kansas emphasized laboratory and field courses rather than purely textbook science. Field courses in botany and geology were listed in the 1868-1869 catalog, along with laboratory classes in chemistry and physics. Professor Snow extended collecting activities of birds and other zoological specimens and studied display techniques, including how to mount birds. His contributions were supplemented by the purchase of a collection of minerals from Germany and the gift of a box of minerals from a government survey party.109 By 1870 the univer-

107. Third Annual Catalogue of the Officers and Students of the University of Kansas, 1868-69 (Lawrence, John Speer, 1869), 14-18.
108. Clifford S. Griffin, The University of Kansas: A History (Lawrence: University Press of Kansas, 1974), 30, 53-54. Snow's interest in meteorology led him to begin in 1868 to systematically record weather data at the university. From these records he produced a monthly report of temperature, rainfall, winds, cloudiness, and humidity for nearly forty years which was published in many Kansas newspapers.
109. Snow, "Letters to His Fiancée," 92, 134. The university charter, dated March 1, 1864, gave the regents authority to spend money for "a cabinet of natural history." See Griffin, The University of Kansas, 30,
Although the state's poor economic climate in the 1870s had an adverse effect on science education, strides made later are evidenced by this laboratory scene at the University of Kansas at the turn of the century.

The university could boast of its valuable collection of geological, mineralogical, and zoological specimens and of its extensive apparatus for experiments in chemistry and physics and for astronomical observations.

In the 1870s the university took over leadership in science education in Kansas, despite serious financial problems. The one university building became entirely inadequate, lacking, among other things, space for laboratories or for the collections which Snow had rapidly enlarged. Fortunately, while economic conditions were unfavorable, a bond issue voted by the citizens of Lawrence, together with some state funds, made possible the construction of a large building. Later known as Fraser Hall, it was first occupied in December 1872. Further funding became difficult and the interior of the building was not completely finished for a number of years. The science professors found themselves with plenty of room and with the latest in laboratory facilities but lacking equipment and supplies as well as storage and display cases for their collections. In some of the chemistry and physics courses the professor could only give demonstrations rather than permit students to conduct experiments. The instructor in physiology lacked illustrative plates and models, and the professor of astronomy had no chronograph.\[110]

Enrollment continued to grow; by 1871 there were forty-five students in the collegiate courses. Interest in science was high and the faculty raised the requirements

by instituting an examination in physics, botany, and physiology for those seeking admission to the scientific course. In 1873 and 1874 zoology, meteorology, physiology, and botany were added to the classical course. Students studied much the same subjects in both courses, but those in the scientific course were required to spend much more time in laboratory and fieldwork.

The economic squeeze began in 1873 when the legislature cut funds for faculty salaries, causing some resignations and other faculty changes. Some senior professors were replaced with young college graduates who drew much smaller salaries.

While these changes were being made, Snow continued as professor of natural science. In 1873 he taught botany to preparatory students, zoology to college freshmen, meteorology to sophomores and seniors, and geology to juniors. His students also formed a Natural History Society. Its members became very active in collecting specimens, particularly insects, and with their help the university's cabinet grew rapidly. Snow evoked the interest and assistance of the entire school and the Lawrence community in his drive to build the natural history collection: for instance, Anna Spears captured a flicker in the cupola of the old university building; Lizzie Yeagley collected a worm-eating warbler which flew in her office window; and a local hunter donated a whooping crane shot near Lawrence.

The collection contained 12,000 specimens by 1873. The total grew to 20,000 in 1874, and another 10,000 were added the next year. Among the specimens on hand in 1875 were 2,000 species of Kansas insects and 300 of Kansas birds. Snow persuaded the legislature to provide $1,000 in 1873 for moth-proof cases to protect the increasingly valuable collection. The accessions in 1874 included 1,000 marine specimens from the Atlantic Coast which Snow collected while a member of a summer study group directed by Alexander Agassiz, son of zoologist Louis Agassiz, on Penikese Island, Massachusetts. Snow, the only Kansan in the select group of fifty students, attended biology lectures and learned improved collecting and specimen preparation techniques.

The fortunes of the other Kansas colleges and universities in the decade after the Civil War varied widely. Some struggled for a time and then closed. Others prospered and continued for many years, including a few that still exist, and several new schools began operations. An attempt will be made here to recount the experiences of those for which some evidence of science teaching has been found.

Highland University continued as an elementary school and an academy, or high school, through the 1960s. In 1867 attendance was over one hundred and the equipment for teaching physics and chemistry was said to be worth $1,200, in good working order, and in constant use. College-level instruction began about 1870, and two degrees were granted in 1872 to students who had some college training before they enrolled. The next year twenty-six of the one hundred seventy students were at the college level, and the catalog listed mathematics, physics, chemistry, zoology, and geology as classical course requirements. Other science subjects were added in the course leading to a B.S. degree. In 1874 enrollment dropped drastically and lack of funds forced major cuts, including a reduction in faculty salaries, but the school was able to survive.

Although St. Benedict's College was empowered to confer degrees in 1868, most instruction continued at the high school level. Mathematics through trigonometry was required, and classes in physics and chemistry were offered. Although the school had $500 worth of scientific apparatus and a cabinet valued at $100, most students in the early 1870s took commercial courses. The Rev. Boniface Verheyen, professor of English grammar, rhetoric, elocution, and physics, taught physics, chemistry, and, probably, any other science offered.

Wetmore Institute prospered until 1870 when it had an enrollment of 125. Primarily a preparatory school, science had a place in the curriculum, as the scientific apparatus was valued at $500. Lane University in the

112. Griffin, *The University of Kansas*, 67-69. Frederick E. Stimpson, a graduate of MIT and professor of physics and chemistry since 1871, was replaced in 1874 by a young Cornell graduate, George E. Patrick.
114. F. H. Snow, "List of specimens added to collection from Jan. 1871 to _______" (pocket notebook), Francis H. Snow, Diaries and Notebooks, 1871-1907, ser. 2/6/6, University Archives, University of Kansas.
115. *Ninth Annual Catalogue of the Officers and Students of the University of Kansas*, 1874-5. (Lawrence: Republican Journal Steam Printing Establishment, 1875).
116. Snow, "Letters to His Fiancée," 138-39. The Penikese Island study group had been started the previous year by Louis Agassiz and has been characterized as the origin of the biological station concept in the United States. See Robert Taft, "The Editor's Page," *Trans. KAS* 52 (September 1949):334-35.
late 1860s offered training from the primary grades to
college and had about one hundred pupils. The
presence of a professor of mathematics and natural science,
the Rev. J. M. Strasburg, is evidence that some science
was taught, although the school's advertisements
emphasized the commercial department. Hartford Collegiate
Institute in the late 1860s had an enrollment of over one
hundred. Asa D. Chambers, former professor of natural
science at Baker University, became principal, and some
scientific apparatus was acquired.

The Episcopal Female Seminary continued in operation
well into the twentieth century under a new name,
the College of the Sisters of Bethany. Throughout the
late 1860s and early 1870s required subjects in the
academic course included physiology, botany, chemistry,
physics, geology, astronomy, and some mathematics. In
the 1870s meteorology, zoology, mineralogy, and addition
al mathematics were offered as options and a science
course, or major, could be formed by substituting science
electives for language requirements. Enrollment in the
academic course ranged from twenty to forty in the
1868-1870 period; when completed, a college diploma
for a "first Degree in Arts" was conferred. Ruth S.
Baldwin was the professor of natural science and
mathematics. Wolfe Hall, the new building occupied in
1871, contained rooms designed as laboratories, and a
large selection of scientific apparatus was said to be
available.

Reorganization at KSAC and
the Dismissal of Professor Mudge

Dissatisfaction with the education provided by KSAC
culminated in the early 1870s. Despite the additional
stress placed on agriculture-related programs, critics charged
that the Morrill Act's purpose was not being fulfilled and too much emphasis was being placed on
classical languages and abstract science. Complaints,
published in a number of newspapers and voiced in the
legislature, argued that the goal of KSAC should be
to give useful education to farmers and those who
intended to enter the mechanical arts, not a classical
education suitable for those planning to go into the
professions. In the field of science this meant practical
applications rather than the pursuit of basic knowl
dge.

This attitude was not limited to Kansas; as George H.
Daniels has shown, anti-intellectualism was widespread
in the United States in the 1860s and 1870s. The two
concomitant demands in education were that the
emphasis on Greek and Latin be replaced by more modern
subjects and that science be "useful" rather than theo
retical. At first scientists applauded the move away from
classical studies, but later many were chagrined to find
that the attack on Latin and Greek frequently was linked
with a desire to eliminate basic science studies.

The attack on KSAC increased. The legislature, early
in its 1873 session, ordered reorganization of the school's board of regents. A new board was appointed
and took office on April 1. During the summer the board
elected John A. Anderson as KSAC president, in place of
Joseph Denison Anderson, a Presbyterian minister in
Manhattan, was a newspaperman, a politician, and one
of the severest critics of the previous administration. The
new board's philosophy was that KSAC was required by
its fundamental charter to concentrate on the industrial
arts rather than the liberal arts, on those more con
cerned with hands and bodies than with mind or
imagination. It directed that the aim of instruction in
science should be to teach a farmer how to apply its
truths to managing a farm and making a profit there
from. Literary colleges, the new board believed, existed
to discipline the mind, and Kansas should not maintain
an agricultural college to do the same thing.

The new regime, in line with these views, made the
study of Latin, French, and German optional and
instituted or expanded classes in dressmaking, printing,
carpentry, blacksmithing, wagon making, and telegra
phy. A six-year course with entry at the age of fourteen
was established, and the requirement that each student
perform manual labor was stressed. Three new pro
fessors were hired—M. L. Ward, mathematics; J. S.
Whitman, botany and entomology; and William Redzie,
chemistry and physics. The school handbook empha
sized that the sciences "may be taught in either of two
ways:—First, as pure sciences; second, as practically
useful to the farmer...Even those sciences which
 relate most directly to agriculture must be re-arranged

120. Kansas New Eng, Leavenworth, August 29, 1866.
121. Superintendent of Public Instruction, Truth Annual Report, 144.
123. George H. Daniels, "The Pure Science Ideal and Democratic Culture," Scarc 15:61703. The attack on science reflected a feeling
that science was becoming elitist and anti-democratic as it changed
from an amateur pursuit to one conducted by professionals. Furthermore, its increasing complexity raised it above the understanding of the average person and it was felt that science no longer supported religion as it had before the general acceptance of the evolutionary theory.
124. Superintendent of Public Instruction, Thirteenth Annual Re
port, 191-99.
and presented to the student with controlling reference
to the use he will make of them.”

Needless to say, these changes did not suit B. F.
Mudge. In fact, some of them appeared to be directed
at him. He was reduced to teaching geology and astron-
omy, preparatory geography, and college elocution. His
long-time friend, Joseph Denison, was unceremoniously
booted out, and his geological studies and fossil collect-
ing were perfect examples of the kind of science those
now in power did not intend to support. There also
undoubtedly was a contest of will and prestige with
Anderson. Mudge felt that the school he loved and had
helped to build was being ruined; Anderson knew that
Mudge had been the true leader of the school for many
years.

During the fall Mudge and Anderson disagreed over
the new course of study and certain administrative
matters. Mudge is said to have declared within the
hearing of students that Anderson was not fit to run the
college. Professors Miller and Detmers also objected
to the new curriculum, particularly to the emphasis on
practicality in science instruction even in introductory
courses. Late in January 1874 the three professors
lobbied the legislature to stop the confirmation of the
board of regents appointed the previous year. They had
no success as the board was confirmed in the senate by a
vote of twenty-four to five on January 30. Mudge, Miller,
and Detmers returned to their jobs, but a week later all
three were peremptorily dismissed without notice or
further pay. Mudge, who was out of work for three
months, sued the college for the $450 in salary he would
have received for that period. He won the initial trial
and was awarded $493.33 and costs; that verdict was
upheld when KSAC appealed the case to the Kansas
Supreme Court.

Although his ego was badly bruised, Mudge was not
hurt financially for in the spring he went to work for
O. C. Marsh, of Yale University, as a fossil collector.
Many of Mudge’s friends were outraged by his dismissal.
Samuel W. Williston protested so strongly that he was
dismissed from his position as a graduate assistant. His
anger at his alma mater never subsided; sixteen years
later he refused an urgent invitation to join the faculty.
Other reactions varied from strong regret over the
dismissals to expressions of gratification that Mudge and
his ilk had been ousted.

At the school, Miller’s position was taken by E. M.
Shelton, but Detmers was not replaced and there was no
professor of veterinary medicine on the faculty until
1888. Mudge also was not replaced. Geology was added
to Whitman’s responsibilities, and fossils ceased to be
the cabinet’s strong point. Later reactions to the 1873
reorganization vary. An 1891 “symposium” claimed that
the college’s weakness in its early days resulted from the
emphasis on classical education and that it became a
more vital and useful school when redirected toward
agricultural and industrial pursuits. On the other hand,
a 1938 faculty committee estimated that it took KSAC
forty years to completely overcome the decline in
academic standards under President Anderson.

Fossil Collecting in Western Kansas, 1867-1875

As noted earlier, fossils were found in Kansas from
the time of the earliest explorers, and Kansas fossils
had a brief period of notoriety in the late 1850s when
they were instrumental in proving the existence of
Permian formations in North America. In the latter half
of the 1860s Kansas fossils again received widespread
attention as collectors found new species and sites for
investigation in the central part of the state. The most
active of these collectors was B. F. Mudge. His first
Kansas finds of note were fossil footprints found late in
1865 about fifty miles north of Junction City. During
the summers of 1866 and 1867 he collected invertebrate
and plant fossils from Triassic and Cretaceous forma-
tions west of Manhattan, from Ellsworth in the south,
and from the forks of the Solomon River in the north.
Mudge sent many of his finds to F. B. Meek, who had
moved to the Smithsonian Institution, for identification
and description. Meek, in turn, sent most of the fossil
leaves and other plant material to Leo Lesqueux, a
Swiss immigrant who was a leading authority on fossil
125. College Symposium of the Kansas State Agricultural College (Man-
hattan: College Symposium Publishing Co., 1891), 24; Hand-Book of
the Kansas State Agricultural College, Manhattan Kansas (Manhattan:
Nationalist, 1874), 14-15.
126. Kansas State Agricultural College, Board of Regents, v. B. F. Mudge,
Supreme Court of Kansas, Case No. 1392, 1877.
127. Elizabeth Noble Shor, Fossils and Flies (Norman: University of
Oklahoma Press, 1971), 54; Nationalist, Manhattan, February 13, 20,
1874.
128. Willard, History of the Kansas State College, 38; Shor, Fossils and
Flies, 21. Williston charged that a large part of Mudge’s fossils and
other geological specimens were discarded after his dismissal.
129. College Symposium of the Kansas State Agricultural College, 19-25.
This source also reports that KSAC “was among the very first free
schools of college grade in the United States where systematic daily
manual work became an obligatory branch of instruction of all male
students, and that it was the first institution of any kind in this country
which reduced the minimum age of admission to such instruction to
fourteen years,” 25. See also Carey, Kansas State University, 58.
130. B. F. Mudge, “Discovery of Fossil Footprints in the Triassic
plants. Mudge also corresponded with O. C. Marsh whose main interest was vertebrate material.\footnote{Melville R. Mudge, who has copies of much of his great-grandfather’s correspondence, interviewed with author, May 2, 1986.}

Although the fossils collected by Mudge drew considerable interest in eastern scientific circles, it was not until the remains of large vertebrates were found near the state’s western border that, once again, Kansas fossils received widespread national and even international attention. This first resulted from a journey of John L. LeConte through central and western Kansas in 1867.\footnote{LeConte (1825-1883) traveled widely in the western United States from 1844 on, published many scientific works, and was active in the Academy of Natural Sciences of Philadelphia.}

An entomologist, LeConte also was conversant with several other sciences and had been appointed geologist for a railroad survey from Sheridan in western Kansas to Albuquerque. He went by rail to Salina, and on June 7, 1867, set out for Sheridan, observing geological formations and collecting specimens on the way.\footnote{John L. LeConte. Notes on the Geology of the Survey for the Extension of the Union Pacific Railway. E.D., from the Smoky Hill River, Kansas, to the Rio Grande (Philadelphia: February 1868), 7-11.} Going up the Smoky Hill River valley he found numerous fossil molluscs in the lower Cretaceous rocks, and near Fort Harker he collected fossil leaves. The latter he sent to Leo Lesquereux whose 1868 paper was the first published in the Americas on Cretaceous fossil plants and was based largely on Kansas specimens collected by LeConte and Mudge and some from Nebraska collected by Ferdinand V. Hayden.\footnote{L. Lesquereux, “On some Cretaceous fossil Plants from Nebraska,” \textit{Amer. Journal Sci. ser. 2,} 40 (July 1868): 91-105. Lesquereux’s title reflects his impression that both LeConte and Hayden’s specimens came from Nebraska. Later he learned that LeConte and Mudge had found their specimens near Fort Harker, Kansas.}

In the Bunker Hill area LeConte found fossil teeth and vertebrae of a shark, and as he moved farther up the valley he noted the chalk formations which long had served as landmarks. When he reached Fort Wallace, army officers there had a number of unusual specimens to show him. Of greatest interest were two or three fossil vertebrae of a large reptile presented by Capt. Theophilus H. Turner, assistant U.S. Army surgeon at the post. William Comstock, an army scout, reported that most of the skeleton of the reptile, many feet in length, was exposed in a chalk formation about fifteen miles to the northwest. LeConte took the vertebrae with him and arranged to have the rest of the skeleton collected and sent to the Academy of Natural Sciences in Philadelphia. On his return to Philadelphia early in 1868, LeConte turned the vertebrae over to the academy, and in March the bones collected by Turner arrived. Edward D. Cope on March 24, 1868, exhibited some of the bones at an academy meeting, mentioning that over one hundred vertebrae and numerous ribs, the pelvic arch and the head had been recovered, and estimated the length of the saurian, or marine lizard, between thirty-four and thirty-eight feet. Some bones of a second
smaller lizard were sent by Turner to the academy at about the same time.\textsuperscript{135}

The discovery of large vertebrate fossils in western Kansas immediately attracted the attention of all interested in paleontology. Although the dean of vertebrate palaeontologists at the time was Joseph Leidy, two of the most interested scientists were E. D. Cope and O. C. Marsh. Both were young, experienced, and supported by family funds which made it possible for them to devote all their time and talent to their interests. At this time they were friendly competitors, but they developed one of the bitterest rivalries in all U.S. science.\textsuperscript{136} Both did some field collecting but obtained many specimens from other collectors, frequently on a contract basis. The consequences of their feud ranged from near battles between collecting parties to much bickering over the names, classifications, and descriptions of specimens. To some extent their competition stimulated public interest, but it is thought by many to have been detrimental to science. Their rush to name and publish new specimens resulted in erroneous descriptions and unfounded classifications while in the field valuable fossil material was lost or damaged in the drive to be first to find new deposits and to extract the most fossils. Although their competition began in Kansas, its worst aspects developed after activity moved to the large dinosaur quarries found farther west.

Despite the excitement generated by LeConte's find and Cope's report, there was no immediate rush to western Kansas to seek out more specimens. At least in part, this was a reflection of the intensification of Plains Indian warfare from the summer of 1867 to the spring of 1869. Although there were no organized scientific expeditions into the area in 1868, the Kansas Pacific Railway promoted several well attended excursions to the end of the line at Sheridan near Fort Wallace.\textsuperscript{137} One small group, organized as a hunting and adventure party by William E. Webb, on reaching the end of the line in September was told of a large fossil near the fort. Webb, with the help of a "professor" in the group, collected the fossil and shipped it to Cope who placed it in a new genus and described it as the first true Plesiosauroid found in America.\textsuperscript{138}

Marsh ventured west in 1868 but did not get to Kansas. He joined a railroad excursion west of Omaha, Nebraska, in August to investigate a report of ancient human bones found at Antelope, Nebraska. At the site he found them to be fossils of ancient forms of the horse, camel, and other animals. He planned to go back the next year but Indian threats in 1869 caused him to delay for a year.\textsuperscript{139}

Kansas did have a very distinguished scientific visitor in 1868. Louis Agassiz, the renowned geologist and zoologist for whom the Emporia Normal School students had named their club, spent a few days in northeastern Kansas and then ventured west. His main interest was glaciation, which in his enthusiasm on the subject, he completely misread for Kansas.\textsuperscript{140} His trip seems to have brought another major western Kansas fossil to the attention of eastern scientists. This one had been found by Col. John B. Conningham and a Mr. Minor near Monument Station on the Kansas Pacific Railway. After Agassiz's visit the find was shipped to the Museum of Comparative Zoology, Cambridge, Massachusetts. When Cope examined this specimen, he described it as a new species in the genus, \textit{Liudon}, previously known in Europe.\textsuperscript{141}

Only Mudge is known to have done much fossil collecting in 1869, and he did not venture very far into western Kansas. During the summer he went up the Republican River valley as far as the northern state line where he found many fossil plants and other specimens to add to the KSAC collection.\textsuperscript{142} In October he accompanied Kansas senator Edmund Ross and two others on

\textsuperscript{135} Proceedings, (1868), 92-93. LeConte. \textit{Notes on the discovery of Union Pacific Railway}, 89.

\textsuperscript{136} Edward D. Cope (1840-1897) was born in Philadelphia of a well-to-do merchant family, educated at the University of Pennsylvania, and served for many years as curator and secretary of the Philadelphia Academy. Othniel C. Marsh (1831-1889) was supported by his uncle, philanthropist George Peabody, educated at Yale University, and devoted his life to scientific research and the Yale collections.

\textsuperscript{137} \textit{Topeka Weekly Leader}, August 13, 1868; Kansas State Record, Topeka, September 2, 1868.


\textsuperscript{139} Charles Schuchert and Clara Mae LeVene, O. C. Marsh, \textit{Pioneer in Paleontology} (New Haven: Yale University Press, 1940), 96-100.

\textsuperscript{140} Kansas State Record, September 30, 1868; \textit{Leavenworth Daily Constitution}, August 28, 1868. Agassiz was traveling with a group of eastern politicians including Sen. Roscoe Conkling of New York. He is reported to have seen the entire plains region from the Missouri River to the mountains as having been deposited by sheets of ice.


\textsuperscript{142} Superintendent of Public Instruction, \textit{Annual Report}, December 15, 1869 (1870), 67.
an expedition, with a military escort, up the Solomon River valley to visit troops stationed in the area and to determine the valley's potential for agricultural and railroad purposes. Mudge concentrated on soils and geology, including fossils, but also noted evidences of ancient Indian occupation. In what now is Phillips County, Mudge found a number of fossils in Cretaceous formations including the vertebrae and other portions of an eight-foot saurian. Returning down the South Solomon River, Mudge noted much exposed magnesium limestone of the same period but found fewer fossils. Although the results of this trip were not spectacular, it was important for introducing Mudge to the large, well-preserved fossils of new species awaiting discovery in western Kansas.

The threats of Indian attack had greatly diminished by the spring of 1870, and Mudge and Marsh felt able to begin serious investigation of the promising Smoky Hill valley. Mudge first went to Colorado where he collected mineral specimens. On the way back he collected fossils from the Cretaceous formations around Fort Wallace.

143. [Robert McBratney] "Exploration of the Solomon Valley," *The Times and Conservative*, Leavenworth, October 23, November 2, 4, 6, 10, 11, 12, 1869.
The vertebrates he forwarded to Cope in Philadelphia, and the molluscs he sent to Meek at the Smithsonian. Cope discovered three new species of reptiles and five new species of fish among Mudge's finds, and in November and December published descriptions of them, including one he named *Liodon mudgei*, the first of several species to be named for the Manhattan collector.  

O. C. Marsh set out in the summer of 1870 with a party of Yale students and graduates on a grand tour of western fossil sites. They first stopped in Nebraska, going on to Wyoming and Utah. In November as they returned east, they stopped at Fort Wallace. Setting out with a military escort toward a rich fossil area known to the officers at the fort, they found a number of major fossils, including the remains of large marine reptiles as much as thirty-five feet in length. Even though the college boys spent more time chasing buffalo than hunting fossils, the party discovered four new species and one new genus in a few days. The party's unusual find, however, was a portion of hollow bone which Marsh identified as the wingbone of an extinct flying reptile, a pterodactyl. Such creatures were known from Europe, but this specimen, the first to be found in America, appeared to be from a much larger creature, one with a wingspread of about twenty feet.  

Another major fossil collector, Charles H. Sternberg, made his first contribution in 1870. Sternberg, who had moved to a ranch near Kanopolis in 1867 at the age of seventeen, was interested in natural objects and soon discovered the concretions found on the nearby sandstone-topped hills could be split open to reveal fossil leaf impressions. He sent his first collection to the Smithsonian in 1870 which passed it on to John S. Newberry of Columbia University. Although Newberry did not publish on any of these specimens for many years, Sternberg persisted in his new pursuit.  

After the exciting finds of large reptiles and fish and, possibly, a flying reptile, collectors and scientists were out in force in the summer of 1871. Mudge collected Permian fossils around Manhattan, Cretaceous molluscs and fossil leaves in central Kansas, and in July went to western Kansas where he found many more vertebrates. Although he kept specimens for the KSAC cabinet, he sent the best items to experts in the East for identification and publication. The molluscs were sent to Meek, most of the plant material to Lesquereux, and most of the vertebrates to Cope. Louis Agassiz at Harvard and James D. Dana at Yale also received items. Many of Mudge's finds were published by Cope and Lesquereux in the yearly report of the U.S. Geological Survey of the Territories. His fossil plants of 1871 included seven new species, including one Lesquereux named *Quercus mudgei*.  

Marsh's 1871 Yale expedition left Fort Wallace on July 5 with a military escort under Lt. James H. Whitten, a young officer interested in fossils. His party found more pterodactyl remains, including additional pieces of the wing bone discovered the previous year and parts of other and even larger species. They also found many remains of large marine reptiles and fish, and a slender, fifteen-foot creature with a broad, duck-like bill which was the first dinosaur found in Kansas, although later determined to be a previously known species.  

Cope, not to be left behind, visited the same area in October. He too found the military very helpful. His escort included Lieutenant Whitten and an enlisted man, Martin Hartwell, who found most of the skeleton of a large fish which Cope named *Portheus molossus* and which became one of the best known of western Kansas fossils. Cope's party was very productive, especially in a rich area south of Fort Wallace which he named Fossil Spring. In a preliminary report Cope claimed to have added many new species, several new genera, and even two new orders, dinosaurs and tortoises, to the finds from western Kansas. As usual he rewarded several of his helpers by naming species after them, including Martin Hartwell "to whose acuteness and industry I owe many specimens."  

Neither Cope nor Marsh wasted time in publicizing the results of their expeditions. On his way west, Cope stopped in Manhattan to examine what Mudge had found earlier in the summer and wrote to the secretary of the American Philosophical Society that Mudge had come up with several new species of reptiles and three of fish. By March 1, 1872, Cope had submitted three
reports with scientific descriptions of his and Mudge's finds, totaling about forty-five pages. He announced at least twelve new species of fish, a tortoise which represented a new genus, and two creatures that resembled the pterodactyls of Europe. Cope said the latter were similar to specimens found by Marsh and might be the same species but "this cannot be definitely ascertained as his species is imperfectly described...." Another aspect of early fossil collecting, even when supervised by a senior scientist, comes out in Cope's article on the new tortoise. As the specimen had to be dug out of rock with pick and shovel many bones were fractured and they suffered further damage in shipment. Cope commented that the parts of the creature described "were reconstructed of over 800 pieces by myself." 153

Marsh was busy in the spring of 1872 writing up the previous year's finds. He recognized that two types of flying creatures were represented in the Cretaceous fossils of Kansas. The pterodactyls, or flying lizards, were reptiles with a wing composed of a membrane attached to one very elongated finger. They could fly but had very little maneuverability. The pterodactyls from the Jurassic Period in Europe were very small compared to the Cretaceous forms found in Kansas. He also realized that his party had found most of the skeleton of a very primitive form of true bird, the first to be found in America, which he named Hesperornis regalis. 154 In describing the new species of marine reptiles found by the 1871 Yale party, Marsh pointed out new features such as dermal plates, or scutes, which he felt might be useful in identifying species, and limbs which had been adapted to serve as paddles. 155 Summarizing the mosasaurid fossils in the Yale collection, Marsh, in May 1872, almost completely restructured the catalog of genera and species published by Cope only a few months before. He also countered some of Cope's derogatory remarks by noting Cope's error in reversing the proper position of the bones of one species. 156

The collectors had another very productive year in 1872. Professor Mudge again ventured north of the Smoky Hill River. After stopping near Hays where he found fossil shells and fish, he went north to Smith County where he met the rest of his party—Prof. G. C. Merrill of Washburn; Prof. P. H. Felker of Michigan Agricultural College; R. Warder of the Indiana Geological Survey; and seven KSAC students. They explored the geology of the valleys of Prairie Dog Creek and several branches of the Solomon River and found many vertebrate fossils. Later in the year, Mudge spent two weeks examining the geology of the Arkansas River valley which became the subject of a paper he presented before the Kansas Academy of Science. In the fall he had visits from both Marsh and Cope. It appears that he gave most of his saurian fossils to Cope, who found fourteen new species among them. 157 The rarer bird-like fossils he passed to Marsh. In July a third visitor was Leo Lesquereux who spotted a number of new species in Mudge's plant material. Lesquereux spent the summer examining plant fossils and sites in the West. On his way to the Rocky Mountains he stopped to collect fossil leaves at Fort Harker where he met Charles Sternberg who thereafter sent all of his plant material to Lesquereux. 158

Cope, working under the auspices of the U.S. Geological Survey of the Territories headed by Ferdinand V. Hayden, fitted out a sizable party for fossil collecting in Wyoming. His plan to visit the Kansas fossil fields later in the season was changed and he spent little time in Kansas except for his stop to see Mudge. Marsh took a small Yale party to the Fort Wallace area where they found more pterodactyl and bird fossils. 159 One was a very fine skeleton, lacking only the head, of a Hesperornis regalis, which he had discovered just the previous year.

When Marsh got back to his laboratory at Yale, he almost immediately looked at the birdlike fossils given to him by Mudge. He decided that two creatures were represented, one a small reptile having a jawbone with teeth and the other a small bird with bioconca vertebræ. He immediately wrote up short notices of the two, naming the bird Ichthyornis dispar. 160 By January, 153 Ibid., 420-22, 433. Collecting techniques were improved greatly during the last half of the 1870s. Cope, Sternberg, Williston, and others gradually developed methods of supporting and holding the fossils together with paste and strips of paper or cloth. About 1880 they began to use burlap strips and plaster of Paris which became the standard procedure and remained so for many years.


156. O. C. Marsh, "On the Structure of the Skull and Limbs in Mosasaurid Reptiles, with Descriptions of new Genera and Species," Amer. Journal Sci. ser. 3. 3 (June 1872):448-64. Mosasaurs were aquatic lizards with elongated, snake-like bodies. Redescription and reclassification of species and genera were to be expected in such a rapidly developing field but Marsh and Cope, rather than cooperating and comparing notes, made separate judgments and pronouncements and then took delight in correcting each other's errors.


159. Schuchert and LeVene, O. C. Marsh, 126.

after working the fossils further out of their matrix, he concluded that the jaw and other bones were from a single birdlike creature with bioconvee vertebrae and teeth in both jaws. This was a sensational discovery for it provided important support for evolutionary theory by, in Marsh's words, doing "much to break down the old distinctions between Birds and Reptiles...." Later commentators have called this the most important discovery of Marsh's early career, or even his entire career. Thus, Kansas fossils closed what T. H. Huxley and other major evolutionary theorists considered the most important break in the animal series.

In summarizing the fossil discoveries in the West in 1870-1872, Marsh mentioned that he had discovered the first pterodactyl fossil found in this country and had been the first to describe three very large pterodactyl species. He rejected Cope's "rediscovery" of two of them and went on to emphasize other mistakes by Cope. Although a great scientist, Cope invited criticism by being so eager to lay claim to new species; he even announced the discovery of three new species in Wyoming by telegram, giving descriptions of only a few words for each.

By 1873 the first phase of fossil collecting in western Kansas had tapered off. Marsh, Cope, and the interested public had turned their attention to areas farther west where large dinosaurs had come to light and where great concentrations of fossils had been found. Only Mudge returned to the Kansas fossil beds. Before he went west, he made several short trips in the state's eastern section to find plant remains for Lesquereux and fossil footprints for Marsh.

Fossil footprints had been known in the Triassic strata of Connecticut since the early 1800s. Edward B. Hitchcock devoted much time to collecting and studying them and had recognized tracks of lizards, turtles and amphibians, and considered three-toed tracks to be footprints of birds. As mentioned earlier, Mudge first encountered fossil footprints in Kansas in 1865. Other footprints in sandstone were found just west of Salina in 1868 by J. B. Hamilton. The 1873 specimens were discovered by Mudge when he saw a clear impression of bipedal footprints in a paving slab while crossing a street in Topeka. He traced the stone's origin to an Osage County quarry where he secured several samples of the prints which occurred in a Carboniferous strata. Closer examination enabled Mudge to determine that these were not bird tracks but marks made by lizard-like creatures that walked on two feet; and there were four different kinds of prints. When Marsh stopped in Manhattan that fall, he took duplicates of each type of footprint, hoping to determine what species had made them.

On his trip to western Kansas in the summer of 1873 Mudge spent most of his time in Trego and Ellis counties, about one hundred miles east of Fort Wallace. Visited by fewer fossil hunters, this area was less picked-over and Mudge located a number of fine specimens of Cretaceous vertebrates. When Cope examined them in mid-October he was of the opinion that four or five new species were found.

In the spring of 1874 Mudge, who had just lost his position at KSC, was hired by Marsh as a contract collector. In May, after a few weeks in the field, Mudge decided he had to replace his assistant. Fortunately, for him and for the science of paleontology, one of the two young men he obtained as a replacement was Samuel W. Williston. An 1872 KSU graduate, Williston credited his love of science to Mudge and said he had taken every course—botany, geology, zoology, mathematics, and others—that Mudge taught. After graduation he worked as a surveyor, took some chemistry courses, and began the study of medicine. His field trips with Mudge introduced him to vertebrate paleontology, one of the fields in which he became a world renowned authority.
As these scenes from a 1911 fossil expedition in Comanche County indicate, the light wagons needed for the terrain had their limitations and breakdowns did occur.
Mudge's 1874 party was in the field until November. Williston found a good pterodactyl specimen only a few days after joining Mudge and, in spite of the rough living conditions, found fossil collecting fascinating. The collecting party was so successful that Marsh, who was notably poor about financial matters, rewarded his assistants with a $200 bonus for the season. 169

The success of the 1874 expedition led to another contract in 1875. Cope made Mudge an offer, but he decided to continue with Marsh. Williston returned as chief assistant at a salary of thirty-five dollars per month and expenses. This " princely" pay reflected his employer's fear that he might go with Cope. Mudge and Williston closed their work in mid-September, after getting a number of fine mosasaur skeletons from northern Ellis and Trego counties and many valuable specimens in the Smoky Hill River valley. 170

The quantity of material found, extracted, and shipped east by the early fossil hunters in western Kansas is amazing in view of the difficulties under which they worked. Except along the Kansas Pacific Railway, the area between Forts Hays and Wallace was almost entirely unsettled in the early 1870s. Some buffalo and other game could still be found but there was no reliable source of water between the river and the railroad, which in some places were thirty-five to forty miles apart. The light wagons, needed to travel in the rough country around the chalk cliffs and outcrops where fossils were exposed, were not designed to haul the heavy pieces of fossil embedded rock. And, except for the occasional lucky find of an intact specimen, weathered out but not shattered or scattered, fossils had to be dug out with pick and shovel and moved by human muscle. Later observers have made much of the Indian threat but the chief enemies were heat, thirst, and dust.

The threat of Indian attack was real in the years 1867-1869 and fossil hunting was curtailed. Even in the early 1870s many parties out of Fort Wallace had at least a token military presence, 171 but Mudge went out with only one or two companions and it seems that he was never seriously threatened. A favorite story about Mudge, recounted by Williston, tells how the professor, when surrounded by a group of mounted but not warlike Indians, puzzled and entertained his visitors by removing his glasses and then capping that by taking out his false teeth. With that display and a little tribute of food and tobacco, the astonished Indians went on their way. 172

Marsh and Cope sent their fossil hunters, including Mudge, Williston and Sternberg, to points outside of Kansas after 1875 although they and others continued to work through the Kansas material. Cope, in January 1875, prepared a detailed summary of the Cretaceous vertebrates from the western United States. He pointed out that, of many species of reptiles and species of fish had been recovered from the formations laid down while the Cretaceous seas covered much of Kansas. Of the reptiles, which included a terrestrial and four flying forms, many had been found by Mudge, and several others by Prof. George Merrill of Washburn. 173 Many of the new fish species also had been found by Mudge. Later in 1875, Marsh published a short summary on birds with teeth. To that date, three species of fossil birds had been found in the Americas, all in Cretaceous formations in Kansas. All were either found or first described by Marsh. 174

In summary, through 1875 the Niobrara chalk of western Kansas contributed a large number of new forms to science; provided evidence substantiating the theory of evolution only a little more than ten years after its first announcement; attracted public attention and support to the relatively new science of paleontology by revealing sea serpents and the first ancient flying creatures in the United States; 175 and inspired a number of Kansans to take an active interest in science.

The Kansas Academy of Science

The scattered teachers of science in Kansas occasionally may have met and exchanged information before the spring of 1867, but the lack of transportation facilities discouraged such meetings. When the railroad down the Kaw Valley advanced to Manhattan late in 1866, it became much easier for faculty members of KSAC, KU, Lincoln College, and other schools on or near the line to call on each other. One such meeting occurred on March 28, 1867, when a Douglas County Teachers' Institute met in Lawrence. Teachers from KSAC, Lane University, and Baker University were 172. Shor, Fossils and Flies, 59. Colbert tells the same, or a similar, story about Cope. See Colbert, "The Great Dinosaur Hunters," 82.
173. Cope, "The Vertebrates of the Cretaceous Formations of the West," 6, 44.
among the visitors who toured the new university building and looked in on some classes. Professor Snow noted that his laboratory was included in the tour and the performance of his newly installed electrical apparatus was praised.  

Although this meeting may not have led directly to the closer association of Kansas scientists, in less than a year steps were taken toward the creation of such an organization. Impetus came from the increasing numbers of science teachers in the state and, in particular, from the arrival of two experienced and well-trained young men to fill natural science professorships, J. S. Whitman at Baker and John D. Parker at Lincoln College. Together with Mudge and Snow, these men led a successful effort to establish an association which greatly stimulated the development and coordination of scientific activities in the state and still exists as the Kansas Academy of Science. John D. Parker, usually credited as the chief proponent, had been a member of the Illinois Natural History Society before coming to Kansas. Shortly after his arrival in Topeka he attempted to interest Kansas scientists in a similar organization. Mudge and others favored the move but feared it was premature. During the summer vacation of 1867, Parker visited Manhattan as Mudge's guest and got his promise of support. In the next few months Parker, Mudge, Snow, and others promoted the idea in correspondence and conversations.  

By March 1868 Parker felt that he had enough support to justify a letter in the Journal of Education suggesting immediate action to form a society. His letter


was favorably received, and on July 6 a published invitation, signed by Parker and sixteen others, called on "all persons in the state interested in natural science to meet at Topeka on the first Tuesday of September next, at 3 p.m., at the college building, for the purpose of organizing a State Natural History Society." Despite low attendance caused by bad weather, an association was formed under the name, Kansas Natural History Society, and officers were elected: president, B. F. Mudge; vice-president, J. S. Whitman; secretary, John D. Parker; treasurer, F. H. Snow; and curator, John A. Banfield. Nine branches for individual sciences were assigned to members of the society. Among the assignments were Mudge, geology; Snow, zoology; Parker, paleontology; Whitman, entomology; and James H. Carruth, botany. A constitution and by-laws were adopted, and a resolution was passed calling for a paper on a natural science topic by each member each year and for two public lectures annually.178

The new society made little progress in its first year other than adding a few members. At the second annual meeting in Topeka in September 1869 attendance was low, and only two papers were presented. They evoked enough controversy, however, to demonstrate some life in the organization. Mudge gave a paper arguing that the earth's internal heat was much lower than claimed by some recently proposed theories. Parker disagreed and spoke at length on the evidence for much higher internal temperatures. Parker gave a public lecture on the "Antiquity of Man on the American Continent" in which he estimated man had been on this continent for three or four thousand years and on earth for about ten thousand. The latter figure he felt was in fair agreement with the Hebrew chronology going back eight thousand years or so. A Dr. Ashbaugh cited facts which he believed placed man on earth twenty or thirty thousand years ago. Mudge and Parker argued that this interpretation was inaccurate and that the Hebrew chronology would prevail.180

The next year was a turning point for the society. Membership increased greatly, and the two-day annual meeting held in Lawrence was well attended. Six papers were read and two public lectures presented. Of most importance was a lecture by Gen. John Fraser, the new KU chancellor, on "The Aims, Organization and Advantages of Scientific Association." This led to a broadening of the society's scope and the adoption of a new name, Kansas Academy of Science. Fraser's commitment to science, together with the work and enthusiasm of Parker, Mudge and Snow, attracted the support needed to assure the organization's success.

The 1870 meeting also marked the beginning of several new lines of scientific endeavor. One was the attempt to collect and catalog all the species of a class of natural objects native to or currently found in Kansas. The first of these efforts was the catalog of Kansas plants which Carruth began and continued to work on for many years. The next was Snow's catalog of Kansas birds; earlier he had prepared a limited catalog of the fishes in the Kansas River. Another new effort was the presentation of papers based on laboratory analyses. William H. Saunders, a Lawrence physician who taught chemistry at the university, read the first of these, comparing the heating and other qualities of Kansas coals with other western coals. Also among the 1870 papers were two by Mudge describing in detail the geological processes and formations. Thus, while Kansas scientists in 1870 still devoted most of their efforts to collecting, cataloging and describing specimens, they also began to subject natural objects to laboratory tests and to attempt to describe natural processes.

The papers presented at the academy's 1871 and 1872 annual meetings continued these trends. At the 1871 meeting held in Leavenworth, Carruth extended his Kansas plants listing and Snow initiated his Kansas birds catalog. Chancellor Fraser lectured on the moon, which led to a lively discussion of whether or not that body rotated on its axis, and John Wherrell read a paper on the Darwinian theory, which raised much comment. In 1872 in Manhattan, F. E. Stimpson pre-

178. Parker, "Organization and History," 4-5. The signers of the invitation included the leading science teachers: B. F. Mudge and J. S. Hougham from KU; F. H. Snow and John Fraser of KU; J. S. Whitman from Baker; John D. Parker of Lincoln, and J. H. Carruth, formerly at Baker. Others were J. A. Banfield, later principal of Leavenworth Normal; David Brookway, formerly on the board of regents of Emporia Normal; Jefferson Robinson, a Topeka physician; J. R. Swallow, state auditor; D. H. Robinson, professor of languages at KU; R. A. Barker, Kansas secretary of state; and three widely respected ministers, Richard Cordley of Lawrence, Peter McVicar of Topeka, and R. D. Parker of Manhattan, a brother of John D. Parker. The seventeenth signer, variously listed as G. E. G. F., and S. F. Chapin has not been further identified.

179. Topeka Weekly Leader, September 17, 1868; Thompson, "Origin and History of the Academy," 11.


181. Thompson, "Origin and History of the Academy," 12. The change in name apparently reflected a desire to broaden the scope of the organization to include such subjects as linguistics.

182. Ibid., Kansas Daily Tribune, Lawrence, September 7, 1870.

183. Leavenworth Daily Times, October 26, 27, 1871; "Proceedings of the Society," Trans. KAS 11(1872):5. Wherrell's paper may have been the first public exposition in Kansas of Darwin's theory of evolution. Mudge never accepted the theory but let his students review the evidence and make up their own minds. Willson and most of the other younger Kansas scientists accepted the theory wholeheartedly. Snow had difficulty reconciling it with his previous beliefs but eventually did so and in his later years taught a course on "The Principles of Evolution."
sented the results of his study of the relation between light production and gas usage for various types of gas lights. This was praised as being “worthy of any veteran society in Europe.” Other analytic studies on the qualities of Kansas limestones and coals were presented by William H. Saunders. Snow and Carruth continued their catalogs and Mudge contributed papers on Kansas geology, as he did every year. Two linguistic studies broadened the range of subjects considered by the academy, while a public lecture on the agreement of the Bible with geological science and a paper by John D. Parker on the “Remoteness of the Final Catastrophe” reflected some members’ efforts to reconcile the new science with old theological concepts.184

In 1873 the legislature made the academy a coordinate department of the State Board of Agriculture. Under this legislation the board was required to publish the transactions of the academy’s annual meetings as part of the Board of Agriculture’s annual report and to make space available to the academy for the display of specimens.185 The first transactions to be published were of the academy’s fifth annual meeting in 1872 and appeared as pages 341-417 of the board’s 1872 annual report.186 This was the final boost needed to establish the Kansas Academy of Science as the major vehicle for discussing problems, coordinating research, publishing results, and attracting public interest and support.

Although John Fraser served as president in 1871 and 1872, Snow, Parker, and Mudge were the leading figures in the academy. Newcomers among the officers in 1874 and 1875 were John Wherrell of Leavenworth Normal; Robert J. Brown, a Leavenworth physician interested in medicinal flora; Edwin Popeneoe, an entomologist and Washburn graduate; and William K. Kedzie, the new professor of chemistry at KSA. Others prominent on commissions and committees from 1873-1875 were professors M. V. B. Knox of Baker, H. B. Norton of Emporia Normal, and G. E. Patric, F. E. Simpson, and F. W. Bardwell of KU. Several of these men were appointed official scientists to the State Board of Agriculture: Snow as meteorologist; Carruth as botanist; Popeneoe as entomologist; and Kedzie as chemist. Although their duties were not defined, Mudge prepared a twenty-page report on the geology of Kansas, and Kedzie traveled to Europe to visit agricultural experiment stations and to arrange for the exchange of publications.187

The academy’s meetings in 1873, 1874, and 1875 continued the trend toward more analytical reports. Jennie Detmers, Kedzie, Patrick, and Saunders presented analyses of soils, rocks, atmospheric elements, and artificial organic compounds. Snow and some of his students reported on behavioral studies of insects. F. W. Bardwell proposed theories, which were quite advanced for the time, on comet’s tails and on discrepancies in observations of the moon’s motions. Mudge described new fossils and how certain geological specimens were formed. The cataloging activities also continued: Carruth went on with Kansas plants; Snow moved from birds to Lepidoptera (butterflies and moths); Knox began on Kansas mammals; and Popeneoe started on the state’s Coleoptera.188

By 1875 the Kansas Academy of Science had gained sufficient prestige to receive some notice in eastern journals and could count nearly every Kansan with training or a serious interest in science among its members. In subsequent years it served as a major coordinating vehicle for scientific efforts in the state and as an important focus of publication for those engaged in such efforts.189 Although major contributions to the advancement of science may have been few, knowledge of great value to the state’s residents was accumulated and coordinated and many other scientific efforts were stimulated by reports in the academy’s Transactions.

Conclusion

In 1875, the closing date of this study, the outlook for science in Kansas was mixed, varying from favorable to threatening, depending on the aspect considered. The Kansas Academy of Science was established and serving as a coordinating and publishing center. Schools, though, at all levels suffered for lack of money. In the colleges this affected much of the research, as well as the educational function. At KSA the lack of funds was compounded by the attitude of the Anderson administration, although its emphasis on so-called practical applications had not completely wiped out interest

186. With the ninth annual meeting, 1876, the Transactions became an independent publication. Some of the papers read at the early meetings were never published and are known only from accounts in newspapers and magazines.
188. See the sixth, seventh, and eighth annual meetings reports in Trans. KAS vols. 2-4 (1873-1875).
189. While there were many earlier scientific societies in the United States, a few were statewide in nature and none west of the Mississippi has a record of publication equal in length and continuity to the Kansas Academy. See Robert Taft, “The Editor’s Page,” Trans. KAS 56 (1955):17.
in scientific advances. Three of the normal schools, seemingly in a position to provide sound and stimulating instruction in science to many would-be teachers, were about to be subjected to legislative enactments which would put two of them out of business. At the university, salary cuts caused some good men to leave, and most private schools had serious financial problems.

Fortunately, some offsetting factors existed. There were more and better scientists in the state than ever before. F. H. Snow at the university, though hampered by the lack of funds, was gaining strong support from elements in the community and state. He and other capable science teachers were attracting outstanding students to the university and other schools. Three or four of the new college buildings in the state contained rooms designed to serve as laboratories, although frequently there was a shortage of equipment. Mudge and Snow were known beyond the borders of Kansas. Mudge, widely respected as a fossil collector, was selected to prepare papers for publication in the reports of the U.S. territorial surveys. Snow, as previously mentioned, was chosen for the course at Penikese Island, and his catalog of Kansas birds was noted in a major scientific journal.190

Although most of the scientific work in Kansas was performed by residents, other scientists still came to collect and study. To mention only one instance, Elihu Hall, a well-known botanist from Illinois, traveled from Fort Scott to Leavenworth and Atchison in 1870 collecting plants and making comparative studies of prairie plants.191

Another scientific development in Kansas in the early 1870s, with wide implications, was Andrew T. Still's formulation of the principles of osteopathy. Still, who practiced medicine in the Baldwin area for many years, persevered in spreading his controversial theories and methods of treatment and succeeded in founding the first school to teach his system of medicine in Kirkville, Missouri, in 1892.192 Also worthy of mention as a development in Kansas and the other prairie states was the complete overthrow about 1870 of the description of the Plains as the "great American desert." The impetus for this change came largely from the railroads when they wanted to promote settlement along their lines, but early scientific investigations also dispelled such perceptions. Much of the railroads' output on the subject was pure propaganda, but some writers approached the question with moderation and some degree of objectivity. R. S. Elliott, although a publicist for the Kansas Pacific, prepared reports which at least had the concept of conducting experiments and reporting on the results, although he admitted his testing was short term.193

As noted earlier, after 1875 the collection of large fossil vertebrates mostly was carried on in Colorado, Utah, Montana, and Wyoming. It also was noted that three Kansans, B. F. Mudge, Charles Sternberg and S. W. Williston, were leaders in the effort. Williston also was the forerunner of what undoubtedly was the most promising aspect of Kansas science in 1875—the group of students from the state's primary and secondary schools that graduated from Kansas colleges and

became scientists of national or international rank. Williston was only the first of note. He was followed by Arthur P. Davis (Emporia Normal, 1882), world authority on irrigation and director of the U.S. Reclamation Service; Warren Knaus (KSAC, 1882), newspaperman but internationally known specialist on Coleoptera; Charles Marlatt (KSAC, 1884), entomologist responsible for U.S. plant quarantine system; William S. Franklin (KU, 1887), MIT professor and authority on alternating currents; Mark A. Carleton (KSAC, 1887), noted plant explorer who introduced durum wheat into the U.S.; Edward C. Franklin (KU, 1888), professor at Stanford and famed inorganic chemist; Ernest F. Nichols (KSAC, 1888), professor of physics at Yale and Columbia and president of Dartmouth; Vernon Kellogg (KU, 1889), professor at Stanford and leader in the National Research Council; Marshall Barber (KU, 1891), international figure in tropical medicine; and Elmer S. Riggs (KU, 1899), a leading paleontologist and curator at the Field Museum, Chicago.

During the 1880s the Kansas educational system also filled local professorships with good scientists. They included Lewis L. Dyche, Erasmus Haworth, and William C. Stevens at KU, and Julius T. Willard and Edwin A. Popenee at KSAC. Only a few years later they were followed by William A. Harshbarger at Washburn, Eli Payne and Robert J. Barnett at KSAC, and Samuel J. Hunter and Hamilton P. Cady at KU. Contemporary with this later group was a number of other notable Kansas-produced scientists, including Barnum Brown, famed

*Capable teachers and eager students were drawn to the science offerings of Kansas schools. Indicative of the content that encouraged an interest in science is this late 1890s experiment with x-ray apparatus and plates at Kansas State Agricultural College. KSAC president, E. R. Nichols, serves as the subject while J. T. Willard conducts the experiment.*
paleontologist and dinosaur hunter of the American Museum of Natural History; Edward V. McCollum, professor at Johns Hopkins and discoverer of several vitamins; David Fairchild, one of the greatest of the plant explorers; Clarence E. McClung, professor at Pennsylvania University, given world recognition for his research in sex determination and chromosomes; E. G. Case noted paleontologist at Michigan University; and Charles A. Kraus, widely known chemist and professor at Brown University.

The flowering of this group of distinguished scientists over a relatively short period in a state only a generation or so after its territorial settlement can only be characterized as remarkable. Our survey of the facilities and equipment available in Kansas up to 1875 has revealed little that might account for this development and leads one to conclude that the credit must lie elsewhere. My judgment is that it must lie in the leadership, inspiration, and sound instruction provided by such men as F. H. Snow, B. F. Mudge, George C. Merrill, John W. Wherrell, F. W. Bardwell, W. K. Kedzie, Martin Knox, and H. B. Norton and their counterparts in the high schools and elementary schools of Kansas.