

**KANSAS GEOLOGICAL SURVEY
OPEN-FILE REPORT 65-2**

**HISTORY OF THE STATE GEOLOGICAL SURVEY OF KANSAS,
1864-1964**

by

Walter H. Schoewe

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Kansas Geological Survey
1930 Constant Avenue
University of Kansas
Lawrence, KS 66047-3726

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Before the Geological Surveys

The first state geological survey of Kansas came into existence on February 10, 1864, when Governor Thomas Carney approved the bill authorizing a geological survey of Kansas effective as of March 1, of the same year. Neither February 10 nor March 1, 1864, however, mark the beginning of geological work in the State or in Kansas Territory. Kansas was part of the Louisiana purchase of 1803; and in 1845, ten years after Texas had won her freedom from Mexico and became a republic, the 7200 square miles south of the Arkansas River and west of Dodge City and the one hundredth meridian were added to the United States (Schoewe, 1948, p. 267). Interest in this newly acquired frontier country led early to governmental explorations such as those headed by Meriwether Lewis and William Clark in 1804, Zebulon Montgomery Pike in 1809, Major Stephen H. Long in 1819, Captain John C. Fremont in 1842 to 1844, Captain Howard Stansbury in 1853 and others, all of which made observations on the geology and other features of the country traversed. To Pike's and Long's observations on "tracts of unmixed sand" can be traced the tradition of Kansas as being part of the Great American Desert, a legend which as late as 1859, at the time of the Wyandotte Constitutional Convention, had influenced the selection of the western boundary line of the state.

From the geological viewpoint most observations were directed towards the economic or mineral aspect. Perhaps the most sought-after mineral resource was coal which was needed for fuel in a country especially noted for the scarcity of timber and wood. Traders, trappers, hunters, early immigrants and missionaries to the Indians were continually searching for coal and other minerals which were deemed

important to the settlement of the new country. As early as 1828, Isaac McCoy, a Baptist missionary to the Indians, reported an abundance of limestone about seventy miles from the western boundary of Missouri. He added "I have seen no coal, but have had no time to search" (Malin, 1950, p. 5; Barnes, 1936, p. 251). On a second expedition later in the same year he reported the finding of coal on the Neosho River near the Osage Agency (approximately four miles south and two miles east of the center of Chanute) and extending southward to the Arkansas River. The coal was thought to exist in great abundance (McDermott, 1945, pp. 414, 426, 440, 449 and 451).

Federal surveys began in 1834. They were motivated primarily by the hope of discovering coal, lead, zinc, iron, building stone, and other mineral resources. Later, beginning about 1846, there was ushered in the period of exploring possible railroad routes to the Pacific coast. All of these surveys were much concerned with the search for coal, building stone materials and water resources. Military expeditions, too, were reporting the occurrence of coal. In June 1846, Lt. J. W. Abert (p. 390) leading a military expedition from Fort Leavenworth, reported a coal mine being worked by Indians on Coal Creek at a point now known as Blue Mound a few miles southeast of Lawrence. This same coal seam and mine were noted also by Brig. Gen. W. H. Emory (p. 11) on a military expedition several days following that of Lt. Abert (Malin, 1950, p. 16). Even before this time F. A. Wislizenus (1847, p. 6) following the Santa Fe trail from Independence, Missouri, on an expedition to the Southwest in March, 1846, observed at Rock Creek, several miles east of Council Grove, outcrops of limestone which he identified as belonging to the Carboniferous rocks of the Missouri coal basin. This correlation of the rocks of eastern Kansas with the Carboniferous (Pennsylvanian) period by Wislizenus is perhaps the first one on record.

In 1852 James Hall made similar correlations from specimens collected between Fort Leavenworth and the Big Blue River by Captain Howard Stansbury on his trip to the Great Salt Lake Basin (1853, p. 16) sometime in the summer of 1849.

In 1853, G. C. Swallow, first state geologist of Missouri and later the second state geologist of Kansas, studied the geology of western Missouri and extended his observations along the west side of Missouri river into eastern Kansas. Swallow at various times was assisted by B. F. Shumard, Frederick Hawn, G. C. Broadhead, J. G. Norwood and Henry Engleman. The importance of Swallow's investigations in the Missouri river valley is best understood from a statement made in his first annual report on the Geological Survey of Missouri dated November 10, 1853: "We passed up thus high (to Bluff City, Iowa) that we might see the Upper Carboniferous rocks, where they were supposed to be best developed, between Bluff City and the mouth of the Kansas; as the commercial value of a large portion of our coal-beds depends upon the position and thickness of these strata, which rest upon them in large portions of the State" (Swallow, 1853, p. 21n).

Although Swallow did not find coal of any importance on his first survey he was convinced that the strata in the extreme northwestern part of Missouri along the Missouri River extending into southeastern Nebraska, southwestern Iowa and eastern Kansas, which for a long time were correlated with the Lower Carboniferous and coal-lacking period, actually were of Upper Carboniferous age and that the entire region was underlain by productive coal beds (Swallow, 1854, pp. 153, 154). Of equal significance was the discovery of Permian rocks in Kansas by Swallow's associate Frederick Hawn. Hawn, a civil engineer with an interest in geology, was appointed deputy surveyor in 1854 by John Calhoun, first surveyor-general of Kansas and Nebraska.

In that capacity Hawn was active in much of the original surveying of the territory.

In 1854 a bill was introduced into the national House of Representatives seeking an appropriation for various public works, including a geological survey in the newly created Territories of Kansas and Nebraska (33 Cong. Second Sess., H. R. Rep't. No. , 36, Washington 1855, Serial 808, p. 1; Taft, 1953, p. 293-4). Congress, however, favored only that part of the bill which was concerned with the improvement of roads, the rest being "deemed inexpedient." Calhoun nevertheless instructed his staff to observe as much of the geology of the territories as possible and take such notes as they could.

As Hawn was not a trained paleontologist, he sent some of the fossils that he collected in connection with his linear survey work to G. C. Swallow and F. B. Meek, his erstwhile associates on the Missouri Geological Survey. Fossils sent to Swallow were those which Hawn considered Carboniferous, whereas those thought to be Cretaceous were sent to Meek for identification and description. Both Swallow and Meek received fossils from Hawn which proved to be Permian and which established for the first time the presence of Permian strata not only in Kansas but on the whole North American continent. Swallow and Hawn announced their discovery of Permian fossils before the St. Louis Academy of Science on February 18, 1858, twelve days before Meek announced his findings. Since priority of the first establishment of Permian rocks on the North American continent was involved in the announcements and because Meek had labored under the impression that all fossils sent to him for study were not to be described by others, a bitter controversy arose between Meek on the one hand and Swallow and Hawn, especially Swallow, on the other hand (Merrill, 1906, pp. 485-486).

The discovery of Permian strata in Kansas, with its attendant establishment of the first known Permian in North America was important from the viewpoint of geology in general. It was of greater value to the early geologists in that it aided in defining the limits where coal might be expected to be found, since Permian rocks were considered non-coal bearing. Rocks of Permian age, however, were considered important for they were known to contain salt and gypsum, two minerals essential to the economy and development of any region (Swallow, 1858, p. 187).

The first geological map to show the Permian in Kansas and probably in North America was published by F. V. Hayden in 1858. Hayden served as the geologist to the expedition to the Black Hills under the command of Lt. G. K. Warren. Hayden's map, entitled "Map of Nebraska", shows the Permian extending as far south as Butler County and occurring also in isolated patches in Brown, Nemaha, Lyon, Morris, Chase, and Greenwood counties, Kansas. This map was based largely on "information derived from Major Hawn's explorations" (Hayden, 1858, p. 144). Maps published in 1862 and 1872 likewise show the Permian in Kansas. Two geologic maps of unusual interest showing the geology of Kansas are those by the French geologist M. Bove and Edward Hitchcock. In 1843 Bove prepared a colored geologic map of the globe accompanied by a paper entitled "Memoire a l'appuni d'un essai de Carte geologique du globe Terrestre." Naturally, this map, insofar as Kansas was concerned, could be no more than a guess. So too, were the colored geologic maps of Edward Hitchcock, president of Amherst College and professor of natural theology and geology, published in 1853. A narrow strip bordering Kansas north of Kansas City was labeled "Primary Fossiliferous Strata to Top of Carboniferous" and the rest of the state as "Secondary Strata." This map together with a second geologic map of the United States, also in

color, but on a larger scale, accompanied Hitchcock's Outline of the Geology of the Globe and the United States in Particular with Two Geological Maps and Sketches of Characteristic American Fossils, a book of 136 pages and five pages of ninety-six fossil sketches. Hitchcock made no claim to accuracy for that portion of the map west of Missouri and Iowa. He stated clearly that ". . . I wish it to be understood that west of Missouri and Iowa the coloring is intended to give only a general view of the geology, and probably in many parts if maybe greatly erroneous. I have made several important modifications of Bove's delineations." (Hitchcock, 1853, p. 72).

What may be the first geological section across the entire east-west distance of Kansas was prepared by Hawn. In September 1859, Hawn wrote to the surveyor general that he had completed a geological section between the Missouri River and a place near present day Denver, Colorado, known at that time as "Gregory Diggins" (36 Cong. Second Sess. Senate Ex. Doc No. 1, Washington, 1860, pp. 171, 172, 173, 197; Taft, 1953, p. 294). Hawn's (1858) paper on "The Trias of Kansas" is also worthy of notice in that it is the first scientific publication naming and dealing specifically with Kansas (Taft, 1953, p. 294). Other important early geological observations were made by J. S. Newberry, (Ives, 1861, Ch. 10), geologist on the Joseph C. Ives expedition of 1857 and 1858 which routed along the Santa Fe trail to the Colorado River basin. In the absence of many rock outcrops, Newberry tentatively assigned a Tertiary age to the area between the Cimmaron Crossing of the Arkansas River, Gray County, and Pawnee Fork near Larned, Barton County. Pawnee Rock in the southwestern corner of Barton County was correctly referred to as the Cretaceous. On the Cottonwood River he recognized Permian strata. Between Council Grove, Morris County, and Fort Leavenworth on the Missouri River all rocks were considered

Carboniferous in age. Newberry reported the mining of coal near Burlingame, Osage County, coal that is still being mined. He noted also the presence of workable coal seams near Leavenworth.

Others besides scientists, engineers, military leaders and missionaries publicized the natural resources of the new country. Among the former were writers such as Edward Everett Hale, who in 1854 published the first book on Kansas (Kansas and Nebraska) and C. B. Boynton and T. B. Mason, who on the basis of their visit to Kansas in September, 1854, wrote A Journey Through Kansas. This book, the second book on Kansas, was published in 1855. These writers, together with numerous others, especially newspaper correspondents, town-site promoters and men interested in Kansas for one reason or another, emphasized the presence and importance of coal, building stone, gypsum, lead, zinc, clay for bricks and pottery in their books, letters and reports (Malin, 1950, p. 60-76).

Various societies, such as the Historical and Philosophical Society of Kansas Territory (organized in 1855), the Kansas Scientific and Historical Society (1859), and the Leavenworth Literary Association (also 1859), considered geology within their scope of interests and aided in spreading the desire for a geological survey (Malin, 1955, p. 339-65). It is, therefore, not surprising that at an early date the citizens of Kansas were conscious of minerals and saw the need for a state geological survey. The need at an early date to have a geological survey in the territory is clearly indicated in a bill, introduced in Congress in 1849, providing for federal aid to state geological surveys in the newly acquired western territories and states. The bill, which did not pass, was sponsored by Stephen A. Douglas, United States Senator from Illinois, author of the Kansas-Nebraska bill and the person credited with the naming of the state. (Malin, 1955, p. 367).

First Attempts: The Territorial Period, 1854-1860

The first request for a geological survey of Kansas Territory submitted to Congress was in 1854 when the Territories of Kansas and Nebraska were created. Since Congress was interested only in matters concerning the improvement of roads in the Territories, no geological survey was authorized. A second unsuccessful attempt to get a geological survey followed in 1855 when the first Legislative Assembly (the "Bogus" legislature) petitioned Congress for appropriations to make a geological survey (Taft, 1954, p. 261). A third try for a survey was initiated when territorial Governor John W. Geary, on January 12, 1857, addressed the opening session of the Legislative Assembly at Lecompton and called attention to the need for a geological survey of Kansas Territory: "A geological survey, developing the great mineral resources of this Territory, is so necessary as merely to require notice. Provision for this useful work should immediately be made" (Journ. House Representative of Territory of Kansas 1857, p. 21). Again no geological survey was authorized.

Initial State Geological Survey -- 1864-1865

The Mudge Geological Survey - 1864

On January 29, 1861, President Buchanan signed the bill admitting Kansas as the thirty-fourth state in the Union. Agitation for establishing a state geological survey, started in territorial days, not only continued but grew in vigor and was strongly urged by a number of newspapers, among which may be mentioned the Leavenworth Times, Leavenworth Conservative, Kansas Tribune (Lawrence) and the Topeka Tribune. Among those advocating a state geological survey was Richard Mendenhall, a Quaker missionary to the Indians who came to Kansas in 1846. Mendenhall, in 1861, wrote to the Lawrence Republican concerning geological work in the state. Among other items he was particularly interested in oil deposits such as had recently been discovered in western Pennsylvania and eastern Ohio (Malin, 1955, p. 367; Lawrence Republican, April 11, 1861).

The first attempt to establish a state geological survey of Kansas since becoming a state was House Bill No. 189, introduced into the House of Representatives by D. T. Mitchell of Lecompton on February 3, 1863. This bill, "An act for establishing a geological survey," advanced in the House to the stage of second reading after which it died a natural death. The fate of House Bill No. 189 was not sufficient to dampen the enthusiasm for securing a geological survey.

One of the most ardent and persistent promoters of a state geological survey for Kansas was Watson Foster. Not much is known of Foster. According to Malin (1955, p. 22) Foster was a resident of Breckenridge (Lyon) County, Kansas Territory by at least 1860. In the federal Census for 1860, Foster is listed as a farmer.

That Foster was not a bona fide farmer seems to be indicated by the fact that he lectured frequently on chemistry before various groups, gave commencement talks, wrote a book entitled Foster's First Principals of Chemistry, and had been a professor in an Illinois college. In 1863 he was appointed professor of natural science or professor of chemistry and geology at Leavenworth College where he remained approximately one year. As a lecturer on chemistry Foster seemingly was successful and popular as is indicated in the accounts published in various newspapers such as the Leavenworth Times, Leavenworth Conservative, Kansas Weekly Tribune (Lawrence), and the State Journal (Lawrence). The Emporia News, at first friendly to Foster, later did not think highly of "that superlative humbug and gas bag." The News further ridiculed him by stating that "We are surprised that he is not delivering that 'lecture' on chemistry, which he learned when he was a boy." (Malin, 1955, p. 23).

Foster did not restrict his interests to chemistry and science in general. Foster was also politically ambitious. Shortly after coming to Kansas, Foster became the clerk to organize a Presbyterian church, a member of the building committee, a member of the board of trustees and also the clerk of the church. In April, 1861, he was elected captain of the Waterloo Rangers and later lieutenant-colonel of the Sixth Regiment of the Southern Division of the Volunteer Militia of Kansas (Emporia News, May 11, 18, 1861). In June 1861, Foster served for a short time as a special deputy United States Marshal (Emporia News, June 8, 22, 1861). On occasion, such as a Fourth of July celebration, Foster gave patriotic speeches. (Malin, 1956, p. 240-248). In 1861, Foster became a candidate for the Kansas legislature from Breckenridge, but was defeated by Mr. David Baker, who, among

other matters accused Foster of being ambitious to become state geologist. In the campaign, Foster had predicted that the legislature would authorize a state geological survey within a year.

After being defeated for office, Foster, in 1862, moved to Douglas County and soon was successful in being elected there to the state legislature. It is believed that House Bill No. 189, introduced by Mitchell in 1863 for the purpose of establishing a state geological survey, was defeated at Foster's instigation. Foster's desire to head the geological survey apparently was well known to others. In 1864, when the geological survey was finally established and several candidates for state geologist were under consideration the Emporia News stated that it hoped that "no money will be thrown away on Foster, because he is entirely unfit for the position." (Malin, 1955, p.23)

Foster was influential in getting others to further his cause and to recommend him for the position of state geologist. Not only did Foster get his friends to write to Governor Carney in his behalf, but he himself wrote to the Governor stating, "Governor, you have the evidence before you that the best part of my life has been actually engaged in the very field, which is now in your power to enable me to enter" (Taft, 1954, p. 435). Furthermore, he also claimed that the other candidates for the position had qualifications that "are certainly far beneath my own". (Among those supporting Foster was B. F. Mudge who later was appointed the first state geologist of Kansas (Taft, 1954, p. 435). Whatever may have been Foster's attainments as a scientist, farmer, lecturer, churchman, or politician it is certain that he was a man of some ability, that he was intensely interested in organizing a state geological survey and that he was ambitious to be its first head.

At the opening session of the state legislature in 1864, Governor Thomas Carney again referred to a state geological survey, stating

"I call your attention to the fact that no steps have been taken, either by the Territorial or State government, to secure a thorough geological survey. It seems to me eminently proper that this subject should engage your careful and considerate attention.

The wealth of Kansas lies in her soil. Whatever may tend to develop that wealth should receive the sanction and support of the Legislature. A geological survey, under competent auspices, would not only bring accurately to the knowledge of the extent and character of our mineral resources, but would materially advance the interests of agriculture, by scientific classification of soils, and by ascertaining their adaptation to the various purposes of husbandry.

It is the opinion of scientific gentlemen that the deposits of coal in this State are far more numerous and extensive than have yet been developed. This single consideration is entitled to special weight in your deliberations. The most fabulous prices which fuel commands in our cities and principal towns must retard their growth, and occasion distress and suffering among the poorer classes. We should ascertain precisely how far coal may be relied upon as a substitute for wood, which, from its scarcity will hardly fail, while the present demand continues, to command such prices as will prove oppressive to the indigent." (House Journal, 1864, p. 26).

Shortly afterwards, J. B. Laing introduced a bill (House Bill No. 10), entitled "An act for establishing a geological survey." The bill provided "for the appointment, by the governor, of a State Geologist, with authority to employ assistants, and to purchase apparatus and chemicals at pleasure to the amount of \$3,500 for the purpose,

- 1st. Of making a classification of the rocks and soils of the different sections of the state.
- 2nd. To visit analyze the salt springs known to exist, and to discover others.
- 3rd. To analyze the soils of the different counties, for the purpose of showing their adaptation to the growth of different grains and grasses.
- 4th. To investigate the coal formation and their mineral deposit.

The first reaction to House Bill No. 10 by the Committee on Agriculture, to which the bill was referred, was adverse. The reasons for recommending that the bill be indefinitely postponed were not only interesting but reveal that the members of the committee were not such "disciples of progress" as they claimed, that their concept of what was practical and what was abstract was somewhat confused and that their opinion of college and university professors was slightly hazy. In their defense it must be stated that the committee did have the best interest of the state in mind and that they were unwilling to impose a financial burden upon the limited population of the state and the taxpayers' ability to support apparently unnecessary projects. In reference to the making of a classification of the rocks and soils the committee reported that

however interesting such classification may be to the very few men in Kansas whose speculative minds and abstraction from practical pursuits would afford leisure for such a study, we do not consider it of such immediate and pressing importance in a practical point of view, as to justify this Legislature in imposing a very considerable burden upon the taxpayers of the State. The simple arrangement and classification of rocks and soils is a work, which, in the judgment of your Committee, can well be left to be performed by the amateur students and professors of our colleges and other institutions of learning, by whom it can be performed with pleasure and profit, without expense to the State -- in the gratification of a laudable curiosity, and of the scholar's love of abstract science.

In regard to the visit to the salt springs and to analyze the salt, the committee reported "We are happy to learn that the business of manufacturing salt has already been commenced, and is being prosecuted with success, and we are of the opinion that the bounty offered to salt manufacturers, by the act of the last session, will afford all needful stimulus in that behalf, and that the analysis provided for by the bill before us, can be secured by private parties whenever necessary, at trifle expense."

Analyses of soils to determine their adaptability to the growing of the various grains and grasses was not considered the best method to determine the relation between soils and the growing of crops. In the committee's judgment "actual trial and experiment" was the "only sure way": "We regard experience as the great teacher and the only sure guide in agriculture, and the best apparatus for testing the adaptation of the soils of the several counties, are such unpretending instruments as the plow, the corn planter, the seed sower, the grain drill, and the horse cultivator, which every farmer will use for himself in testing the capacities of his soil, providing he can save money enough after satisfying the claims of the tax collector, for the purchase of such tried and approved apparatus!"

Conceding the importance of investigating coal and other mineral deposits, the committee was of the opinion that there was no "pressing urgency" in doing so; for even though should coal be found in large quantities, it probably would not be mined because of the scarcity and high price of labor as was exemplified, according to the committee, in Illinois, "There coal is known to exist to an almost unlimited extent [and] remains undisturbed in the bowels of the earth, from the scarcity of labor and capital." The committee stated further that "the enormous prices now charged for firewood in our principal towns and cities, in the immediate vicinity of large forests, demonstrate most clearly that no coal discoveries could be rendered available at the present crises, while labor remains scarce and high, as at present."

In concluding their objections to the geological survey, the committee expressed itself as being against haste and in favor of cautions and economy. Fear was also expressed that there might be some who would benefit by the survey at the expense of the citizens at large.

The combined paragraph of the committee's report is a gem:

"In conclusion, we may be permitted to remark, that, though we are disciples of progress, and are willing and eager to learn, we deem it advisable, for the permanent growth and future prosperity of our State, that we should 'hasten slowly,' lest, preadventure, we should make 'more haste than speed,' and that, in view of the limited population and tax-payers' ability of the State, instead of running the car of progress, 'high pressure' system, we should decidedly incline to favor the narrow gauge, singletract, low pressure style, with Prudence ever on the lookout -- Economy, master and conductor of the train -- Caution standing ready to 'put down the brake,' and all hands on the watch to prevent dead heads from stealing a ride at the expense of the honest stockholders." (House Journal, 1864, pp. 91-3)

The committee's objections, however, did not prevail and the bill to establish a geological survey was passed by the House of Representatives by a vote of forty-eight to twenty. Soon afterwards the Senate passed the same bill with some amendments to which the House concurred. The first amendment was in reference to the name which was changed from "an act providing for a geological survey" to "an act providing for a geological and mineralogical survey." A second amendment cut out section one and inserted "Sec. 1. The Governor is hereby authorized to appoint with the consent of the Senate a State Geologist for the state of Kansas, whose term of service shall commence the first of March, A. D. 1864." Amendment 3 was concerned with the payment of bills for services rendered or expenses incurred by the State Geologist who, according to the ~~amendment~~, was required to present a detailed statement specifying the number of days of service rendered and the items of expenses listed and verified by affidavit. Payment could only be made after the Governor had approved the bills and had them filed with the auditor of State. Amendment 4 required the State Geologist to enter into a bond to the State of Kansas for five thousand dollars and prescribe the oath of office. Section six related to the Governor's power to remove the State Geologist for reasons of neglect, and

incompetency and "to fill all vacancies that may occur by death or otherwise."

The bill as amended was approved by Governor Thomas Carney on February 10, 1864, and published as below.

(Session Laws, 1864, Chapter LXIII)

An ACT providing for a Geological and Mineralogical Survey.

Section 1. The Governor is hereby authorized to appoint, with the consent of the Senate, a State Geologist for the State of Kansas, whose term of service shall commence on the first day of March, A. D. 1864, and end on the first day of March A. D. 1865.

Section 2. The State Geologist shall procure the necessary regents and all the requisite apparatus for quantitative and qualitative analysis. He shall procure the necessary assistance and proceed to classify the rocks and soils of each county of the State. He shall visit and analyze the salt springs already discovered, and use due diligence in efforts to discover others. He shall investigate coal formations and other mineral deposits, by the various appliances known to the departments of geology and mineralogy. He shall analyze the soils in the several settled counties, report their depth and show their adaptation for the growing of particular grains and grasses. He shall immediately report any important discoveries of valuable deposits or other matters of great importance to the State. He shall, during the current year, collect and label a geological cabinet, illustrating the geology of Kansas, and shall deposit the same with the State Librarian.

Section 3. He shall, between the first day of November and the first day of December, A. D. 1864, make and deliver to the Governor his annual report, which shall contain a complete detail of his labors and discoveries during the year.

Section 4. The Governor is hereby authorized to direct the Auditor of the State to draw his orders on the State Treasurer for such sums as, in his judgment, may be necessary for the successful prosecution of the survey, said sums not to exceed in the aggregate thirty-five hundred dollars during the year. These orders shall be marked "Geological Survey:" Provided, that no bills or services rendered, or expense incurred by the State Geologist, shall be paid until a detailed statement, specifying the number of days service, and the items of expenses verified by affidavit, and approved by the Governor and filed with the Auditor of State.

Section 5. Before entering upon the duties of his office, the State Geologist shall enter into bond to the State of Kansas in the sum of five thousand dollars, with security to the satisfaction of the Governor of the State, conditioned that he will faithfully and properly perform the duties of his office, and he shall take and subscribe the following oath:

"I _____, State Geologist for the State of Kansas, do solemnly swear that I

will support the Constitution of the United States and the Constitution of the State of Kansas, and faithfully discharge the duties of my office as prescribed by law, according to the best of my ability."

Section 6. The Governor shall have power to remove such appointee for incompetency or neglect of duty, and to fill all vacancies that may occur by death or otherwise.

Section 7. This act shall be in force from and after its publication once in the Topeka Tribune.

After Governor Carney signed the bill authorizing the establishment of the first state geological survey, a resolution was passed in the House of Representatives recommending G. C. Swallow for the position of state geologist. Swallow had served as state geologist of Missouri from 1853 to 1859 and perhaps more than any other person was better acquainted with the geology of eastern Kansas and was therefore well suited to become the first State Geologist of Kansas. In connection with his studies in western Missouri, Swallow had investigated the geology on the Kansas side of the Missouri River. It was logical for those recommending him for state geologist to point out in the resolution that "Swallow . . . possesses knowledge of this part of the country (eastern Kansas) that will enable him to make a better survey, and give us much more information for the same amount of money than any other man" (House Journal 1864, p. 454). Swallow was also being supported by the Leavenworth Conservative (Taft, 1954, p. 263, note 7). Unfortunately for Swallow, Watson Foster wanted to be state geologist. To eliminate Swallow as a candidate for the position, Foster wrote to Governor Carney on February 22, 1864, stating his own qualifications for the position and also claiming to have written the geological survey bill (Taft, 1954, p. 261 and note 5, p. 263). In this letter Swallow was accused of having been active in the pro-slavery cause and that in 1856 he had contributed to the aid of Missouri "border ruffians" in one of the invasions of Kansas (Taft, 1954

pp. 261 and 263, notes 5 and 6: Leavenworth Conservative, Jan. 19, 1864). This damaging letter was probably the main factor contributing to Swallow's failure to be selected state geologist. Although successful in eliminating Swallow for the position Foster himself got into political difficulties which eventually cost him the position he desired so much. As stated elsewhere in these pages, the Emporia News was especially bitter in its opposition to him and hoped that Foster would not receive the appointment. With Swallow and Foster out of the running, B. F. Mudge was the only other candidate who either applied or was proposed for the position. Mudge, who had gained a reputation far and wide as a lecturer since coming to Kansas in 1861, was invited to address the legislature in 1864 while the agitation for the survey was under way. His lectures on the geological resources of the state were so well received that without doubt they influenced the legislature to pass the bill before them to organize the State Geological Survey (Leavenworth Daily Times, January 28 and 29, 1864).

Mudge was not the first choice for state geologist, and apparently he did not apply for the position as is suggested by the fact that he had recommended Foster. This recommendation appeared on a petition signed by a number of members of the House of Representatives urging the selection of Mudge (Taft 1954, page 437, note 8). On February 15, 1864, Governor Carney appointed Mudge State Geologist of Kansas.

An examination of the act providing for a geological and mineralogical survey reveals an ambitious program, especially when it is realized that the survey apparently was to be completed in one year and that the actual time limit for the major portion of the work was to be either eight or nine months. According to section 3 of the law establishing the survey, the state geologist was directed to make and deliver

to the governor an annual report containing "a complete detail" of work accomplished and discoveries made sometime between November 1 and December 1. Since Mudge's term commenced on March 1, only eight or nine months were left for him to carry on the major program of the Survey and make his annual report. The law specified certain duties to be performed such as classifying the rocks of each county, visiting the twelve salt mines given to the state by the federal government (Schoewe, 1953, p. 133-134, 148-150; Drapier, 1859, p. 574) as well as discovering new salt springs if possible, investigating the coal formations and other mineral deposits and collecting rocks and fossils for display cases housed in the State House under the care of the state librarian. The law stated further that the state geologist was also to classify the soils of each county and to analyze those of the settled counties, reporting their depth and showing their adaptation for the growing grains and grasses. This work is now performed by the State Board of Agriculture and the federal government and is still not completed after almost one hundred years since the project was started. That was the program which Mudge was required to accomplish in no more than one year with only \$3500 at his command and a territory of 82,276 square miles (most of it unknown from the scientific aspect) and with transportation facilities to traverse the state limited chiefly to horse and buggy.

When Mudge finally completed the organization of the Survey his staff included Frederick Hawn, a civil engineer, as chief assistant; G. C. Swallow, the unsuccessful nominee for the position of state geologist, paleontologist; Tiffin Sinks, M. D., chemist and meteorologist; and C. A. Logan, M. D., who was to report on the botany and sanitary relations of the State. The selection of G. C. Swallow on the staff of Mudge's survey is surprising and noteworthy in view of the fact that Swallow had

been rejected for state geologist, to which position he was the first person to be recommended in the House of Representatives a month or so earlier. Swallow's rejection, as stated elsewhere in these pages, is attributed mainly to the damaging accusations of Watson Foster, ardent promoter of the survey and aspirant for the position of state geologist. Furthermore, it is also strange that Foster was not appointed to the staff since Mudge beforehand had recommended him for the position of state geologist. Why Sinks and Logan should have been added to the survey staff is not clear since the original bill creating the survey contained nothing in regard to meteorology, botany, sanitary relations or matters pertaining to health. The Kansas Educational Journal for April, 1864, in announcing and describing the personnel of the geological survey staff, refers to Dr. Logan by saying "We would call special attention to the request to send Botanical specimens to Dr. Logan, as directed in another article in this number. Much can be done in this way to aid each profession in gathering information in regard to his particular department. . ." (Taft, 1954, p. 262).

How much was accomplished by Sinks and Logan is not known since Mudge's annual report does not contain any account by these two staff members. As stated in Mudge's annual report the work accomplished "could be but little more than a general reconnaissance. This allowed so short time to each county that no detailed report of any could be given." (p. 4) On the basis of the report most counties visited were in the eastern part of the State. The work done by Mudge and his staff, although considered by him as of a "reconnaissance" nature, nevertheless was important and was the only type of work that could be expected with a limited budget, small staff, large area to be covered and such a short time to work. What was accomplished is best determined from Mudge's report First Annual Report on the Geology of Kansas, consisting of

fifty-seven pages and published in pamphlet form in 1866. The report is in two parts: Part First, twelve pages devoted to the general geology or stratigraphy of Kansas with slight attention to structure; and part Second, pages 17 to 57 entitled "Economical Geology." Most consideration in Part I is given to the Upper Carboniferous (Pennsylvanian) of eastern Kansas especially as it related to coal and its distribution which, according to Mudge (p.6), extended as far west as Fort Riley. From the report it is clear that field work extended throughout eastern Kansas and that the geologist of that time had a fairly good idea of the general stratigraphy of that part of the state. A detailed stratigraphic section measured primarily in Leavenworth County (augmented by data obtained from the Leavenworth coal shaft and borings made in either 1863 or 1864 under the direction of Hawn and Swallow) is included in the report with the statement that it "will represent very closely the thickness of the strata in the northeastern part of the State, and approximately a large extent south of the same" and "is a guide to all the northern and eastern part of the State, wherever it may be desirous to sink a shaft for coal" (Mudge, 1866, pp. 7, 9). Swallow studied the Permian in the valley of the Big Blue River north of Manhattan and Hawn made observations in the Smoky Hill Valley farther west. The extent of the Permian area had not been worked out. Rocks of the Cretaceous Dakota sandstone in a belt crossing Smoky Hill and Republican rivers west of Fort Riley were incorrectly assigned to the Triassic. The Cretaceous was recognized but its extent had not been mapped. Of special interest in connection with the Cretaceous strata was the recognition for the first time of chalk in Kansas: "We have good reason to believe that an abundance of the article will be found. So far as our knowledge extends, there appears to be a closer resemblance between our Cretaceous and the English

than any other in the United States." (Mudge, 1866, p. 12). Glacial drift loess of bluff, as it was then called, and alluvium were also investigated. The origin of the glacial materials in north-eastern Kansas is best seen from the following statement: "The whole circumstances show that however strong may have been the action of glaciers in drifting these eratics (sic) across the country in other places, they could have owed their present position in Kansas only to icebergs." (Mudge, 1866, p. 14).

Part II of the report, "Economical Geology," is a general review of the occurrence of coal, including lignite, lime, marble limestone, hydraulic limestone or cement, gypsum, alum, salt, sandstone, lead, zinc, and iron. The presence of oil or petroleum seeping out at the surface was noted in several places in eastern Kansas and also in the salt territory. Mudge was of the opinion that "The results of our observations in Kansas is, that the indications are sufficiently strong to justify the expenditure of capital to test the quality of the oil, which certainly does exist to some extent The question cannot be considered settled without numerous borings to a depth of eight hundred to one thousand feet." (Mudge, 1866, p. 32). Much of the second part of the report is devoted to salt, including descriptions of the famous Tuthill salt march, (Schoewe, 1953, pp. 148-150) and observations on the manufacture, purity and statistics of salt and the theory of salt springs. An appendix of two pages concerning elevations in the state concludes the report.

Even though the meagre appropriation allotted for the first geological survey amounted to the small sum of \$3500, Mudge is reported (Thompson, 1885, p. 5) to have spent only two thousand dollars, an expenditure which perhaps is best explained by the fact that the time devoted to field observations could hardly have been more than eight months at the most.

Mudge was required to make and submit to the governor an annual report describing in detail all work done between March 1 and either November 1 or November 30, but no provision was made in the law for the publication of the report or for any other scientific report by the staff members. Thus Mudge's report for 1864 did not appear in print until 1866, approximately the same time that Swallow's report for 1865 was published. Interesting too, is the fact that no geological map of Kansas was included in the published report although it is likely that Mudge may have prepared and submitted a geological map of the state to the governor sometime in November of 1864. In any event, Mudge prepared and published a geological map of Kansas. The map entitled "A Map Showing the Superficial Strata of Kansas" (Fig.) first appeared in the Fourth Annual Report of the State Board of Agriculture (1876, p. 127). At that time Mudge was serving as the geologist for the Board of Agriculture.

The Swallow Geological Survey - 1865

The first state geological survey of Kansas terminated on February 28, 1865. Without doubt the authorization of the survey for but one year was based upon the expectation that all projects enumerated in section 2 of the law establishing the survey would be completed within the prescribed period of time, an impossible task as must have been realized by March 1, 1865. The ground work for geological work in the State had been laid by Mudge and his staff and the recognition of the need for the continuation of the geological survey apparently had crystallized. It is not surprising, therefore, that Governor Samuel J. Crawford, in his annual message to the legislature in 1865, recommended that an appropriation be made to complete the geological survey started by Mudge, which he stated was "all-important to the development of the Agricultural and Mineralogical resources of the State" (House Jour. for 1865, p. 20). As Mudge had accepted a professorship of "natural history and natural science" at Kansas State College of Agriculture at Manhattan he was no longer interested in being state geologist. His interest in the geological survey, however, had not abated for on invitation, he again addressed the legislature in behalf of the survey. On the basis of Governor Crawford's recommendation for an appropriation for the geological survey, the matter was referred to the Committee on Agriculture and Manufacturing for consideration. In the meanwhile another bill, House Bill No. 77, was introduced by S. J. H. Snyder into the House of Representatives for raising funds to test the geological report concerning the occurrence of coal in the state (House Jour. for 1865, p. 144). This bill, which had advanced to its second reading, was referred to the Ways and Means Committee for final consideration, but was

reported back with the recommendation that it be rejected (p. 170). The Committee on Agriculture then introduced House Bill No. 165, "An act making appropriation for a geological survey." (p. 257). On the third reading it passed by a vote of fifty-three to fifteen after Mudge had delivered his lecture to the legislators on the geology of Kansas (p. 358). The Senate passed the survey's appropriation bill (p. 392). The bill authorizing the second state geological survey was approved by Governor Crawford on February 11, 1865 and read as follows:

Session Laws, 1865 (Chapter XL)

Section 1. The Governor is hereby authorized to appoint, with the consent of the Senate, a State Geologist for the State of Kansas, whose term of service shall commence on the first day of March, eighteen hundred and sixty-five.

Section 2. That the sum of seven thousand five hundred dollars, or so much thereof as may be needed, is hereby appropriated out of any money in the State treasury not otherwise appropriated, for the prosecution of the geological survey for the year eighteen hundred and sixty-five: Provided, that services be rendered or expense by the State Geologist shall not be paid until a detailed statement, specifying the number of days' service and the items of expenses, verified by affidavit, and approved by the Governor, be filed with the Auditor of State.

Section 3. The Auditor of State shall issue his warrant on the Treasurer of the State for such accounts as the Governor shall approve.

Section 4. This act shall take effect and be in force from and after its publication once in the Daily State Record.

The law of 1865 differs from the legislation establishing the first state geological survey in several respects. In the first place, the new law contained no section outlining the duties or projects of the survey. Secondly, no termination date for the survey had been set. Also, the amount appropriated had been raised from \$3500 to \$7500. The 1865 law, moreover, did not require an annual report to the Governor. Presumably, the provisions as to duties and reports were taken for granted since Governor Crawford's recommendation was for the completion of the survey started by Mudge.

As in 1864, a resolution originating in the House of Representatives was passed recommending G. C. Swallow for the position of state geologist, this time, however, with success for on February 17, 1865, Governor Crawford, with the consent of the Senate, appointed Swallow the second state geologist of Kansas. Professor G. C. Swallow, paleontologist on Mudge's survey, was originally from Maine. From 1851 to 1853 he was associated with the University of Missouri as professor of chemistry, geology and mineralogy. On February 24, 1853, the state geological survey of Missouri came into being and Swallow was appointed its first head.

Swallow's staff on the Kansas survey included Hawn, Sink and Logan—the same personnel that had served with Mudge during the previous year. Field work in 1865 was confined mostly to the eastern and central parts of the state, largely because of Indian troubles farther west. The survey was in large part of a continuation of Swallow's geological studies carried on while state geologist for the Missouri survey, partly an extension of his work and report upon the collections of Major Hawn published in 1858 (Thompson, 1855, p. 6) and partly a continuation of the work started by the Mudge survey.

On the basis of Swallow's Preliminary Report of the Geological Survey of Kansas (published in 1866) the rocks in the southeastern corner of the state, in Cherokee county, were for the first time correctly correlated with the Lower Carboniferous (Mississippian) and lead-bearing rocks of southwest Missouri. There was not sufficient time in the field to examine the rocks for lead, although Swallow stated that "deposits and veins of lead may be expected in Kansas as well as Missouri" (Swallow, 1866, p. 48). The Mississippian rocks were found to total 120 feet in thickness. Swallow estimated the coal-bearing or Upper Carboniferous rocks to be

two thousand feet in thickness and to underlie an area of 17,000 square miles, as compared to 22,000 square miles as estimated earlier by Mudge. In the coal-bearing rocks Swallow recognized twenty-two distinct and separate seams of coal ranging in thickness from one to seven feet (Merrill, 1906, p.527). The Permian rocks were further studied and found to be 704 feet thick. Rocks known today as Cretaceous in Saline county were incorrectly assigned to the Triassic and Cretaceous. Tertiary strata were not studied although they were known to exist. Quaternary rocks were found to be more or less the same as those investigated by the first geological survey.

Following the law of 1864 relative to the geological survey, detailed work was carried on in several eastern counties. Miami county was studied most thoroughly and what may be the first geological report published by the initial state geological surveys is the Report of the Geological Survey of Miami County, Kansas^{by} Swallow and Hawn. The Miami county report, consisting of twenty-four pages and a map, was published in 1865 in Kansas City, Missouri, and was later incorporated into Swallow's Preliminary Report, without, however, the map and with different pagination. Hawn worked in Brown, Butler, Chase, Doniphan, Greenwood, Linn, Lyon, Morris and Osage counties and prepared short reports on each county for the Swallow report.

When the initial State Geological Survey was established, the law stipulated that the soil was to be classified and that the soil in the settled counties was further to be analyzed for the purpose of determining its adapt^aability to the growth^{of} grains and grasses. In other words, the Survey was not only to study the mineral resources as commonly understood but it was also to undertake the work now performed by agronomists, soil conservationists, and other specialists of the State Board of Agriculture and federal Department of Agriculture. Botany and meteorology were also

to be considered as well as matters pertaining to health. In substance, the State Geological Survey was in reality a natural history survey. In keeping with such a survey, a separate report by Tiffin Sinks on the "Climatology of Kansas" and one by C. A. Logan on "Sanitary Relations" were included in the Swallow report.

Swallow was especially well suited for a diversified survey. This is attested by his opinion as to what a geological survey should accomplish as given in his introduction to his annual report and by statements made in connection with various reports while state geologist of Missouri. In his annual report as state geologist of Kansas, Swallow listed eight items which a geological survey should determine. Among those should be noted items six to eight, in which he said:

"6th. As the soil is the most valuable of all the mineral formations, it should be particularly described, its varieties designated, and the adaptation of each to the staples of the country; and such improved modes of culture as the soils and climate and scientific deductions indicate as important, should be noted."

"7th. The trees, shrubs and herbaceous plants should be examined, and their uses designated."

"8th. The climate should be investigated in its relation to health and the industrial arts, particularly that of agriculture; as success in that more than in any other pursuit depends upon the weather." (pp. 5-6)

Judging from statements made while state geologist of Missouri, Swallow was not only a scientist but he was also a great promoter much interested in the general welfare of the state and anxious for it to become self-sufficient. He especially deplored the fact that most things were being imported into Missouri when Missouri had all the natural resources at hand. "The result is, we, in this land of mighty forests, are importing and paying three prices for our lumber. Our houses, plank roads, and fences, cost twice their usual value. We 'go East' for our agricultural and mechanical implements of every grade, from the plow to the butter stamp. With iron-mountains and a vast area of rich coal-beds, we import every article of Iron,

from the anvil to the ten-penny nail. Our mineral veins contain nearly every paint from the costly smalt blue to the yellow ochre; and yet all we use, with perhaps a single exception, comes from a foreign market. While we are exhausting the richest soil the sun shines upon, some of our crops are no better than those harvested from the once barren hills of New England." [(Malin, 1950, p. 36-37; Swallow, 1854, pp. 35-53).] In regard to the survey's function concerning lumber and the fact that Missouri was importing annually 50,000,000 board feet of it, Swallow wrote that "our soil is actually groaning beneath the enormous load of the very best living timber. Our Geological Survey will point out the best lumbering regions and mill sites There is no physical reason why St. Louis should not export several times as much lumber as she now imports." Soil was exceedingly important to the general welfare of the state and hence the Survey needed to be interested in soil; especially in regard to its suitability for the growing of various crops and also to its conservation. Swallow, who might be considered a pioneer conservationist insofar as Missouri and Kansas are concerned believed, (although he advocated an agricultural college), that the Geological Survey "is the best possible arrangement to supply [the farmers'] present wants, to give them such information as will enable them to adopt the best modes of culture to prevent the exhaustion of their rich soils" and that "the Geological Survey will point out the means of redeeming these farms . . ." wherever the soils had been depleted.

The laws establishing the initial state geological surveys in Kansas contained no provisions for the publication of reports. No report was published during Mudge's administration. In 1865, while Swallow was state geologist, the report on Miami county was published but under what circumstances and authority is not known.

In January, 1866, Senate concurrent resolution No. 21, was presented to the legislature for the purpose of printing a geological report. At the same time a concurrent resolution, No. 17, "On printing report of geological survey" was under consideration by the House (Sen. Journal, pp. 113, 116). The House resolution was amended by Auley McAuley by giving one hundred copies of the report to Swallow and twenty-five copies each to Dr. C. A. Logan, Dr. Tiffin Sinks, and the Atchison Coal Company. The resolution was further amended to include twenty-five to the St. Louis Petroleum and Mining Company and the like number to the Valley Company, the Mound City Petroleum Company and the Osawatomie Salt Company. Apparently fearing that there might not be an end to amendments increasing the number of reports to be distributed, W. A. Phillips moved to lay the resolutions on printing on the table. The motion, however, was lost whereupon E. H. Sanford moved that the whole matter of printing the geological report be referred to the Committee on Printing. Sanford's motion prevailed and the resolution was thus referred to the Committee on Printing. (H. J. 153-4):

In the meantime B. F. Mudge was again invited to address the legislature on the mineral resources of Kansas, the lecture being scheduled for Friday evening, February 20, 1866, in the Hall of Representatives. But not all was well for the survey, for shortly afterwards a committee consisting of three members of the House and three from the Senate was appointed to investigate all matters appertaining to the state geological survey. As a result, Senate concurrent resolution No. 34 in relation to charges preferred in the matter of the geological survey was read a first time and laid over under the rule. This resolution was concurred in by the House (~~House Jour.~~ 308, 327). The matter of printing the geological report

(House concurrent resolution No. 35) was brought up again in the House but J. M. Harvey moved to postpone action on the resolution until the special joint committee appointed to report on the charges preferred against the survey had made its report. Harvey's motion was defeated. S. M. Brice then moved to consider the question of printing. The motion being carried, the resolution was voted upon and was rejected (H. J. 481). Later, Mr. Phillips, reporting for the joint committee in reference to the geological survey, made the following statement:

"The joint committee, to whom was referred the geological surveys of 1864 and 1865, have had the same under consideration and after taking evidence of the same, beg leave to recommend, 1st. That 1,000 copies of the reports of Professor Swallow, State Geologist for the year 1865, be printed by the Secretary of State. 2nd. That the fossils and reports collected and made by Professor and Major [Hawn] in 1864, at present at the headquarters of the geological surveys, be immediately sent by Prof. Swallow to the State Librarian and that Prof. Mudge, or other paleontologist in his employ be authorized to classify and arrange the same. 3rd. That 1,000 copies of the report of Prof. Mudge, State Geologist for the year 1864, be printed by the Secretary of State, if a copy is furnished within one month from the passage of this bill." (H. J. p. 561)

The reports of Mudge and Swallow were published in the same year, 1866.

It is likely that Swallow's report appeared first although there is no direct evidence on hand to verify the assumption. Originally, only Swallow's report was under consideration for printing. Later, when Phillips reported for the special and joint committee appointed to investigate the geological survey, the recommendation not only favored the printing of Swallow's report but provided for the printing of one thousand copies of Mudge's report if Mudge presented or furnished copy of his manuscript within one month from the passage of the bill. The conditional word "if" in the bill suggests that Mudge's manuscript had not been submitted for publication up to that time and, conversely, that Swallow's report was ready for the printer. There was no question about the report of Swallow but there was in

regard to the report of Mudge. No date is given in Mudge's letter of transmittal¹ in his manuscript and final printed report, whereas Swallow's letter of transmittal² is dated "Leavenworth, January 8, 1866." It thus appears reasonable and logical that Swallow's printed report preceded that of Mudge. Maps had been drawn to accompany the report by Swallow and his staff. These maps, however, were not printed or at least not incorporated in the report when printed.

Although the legislature of 1866 adopted a resolution to extend the surveys to the one hundredth meridian, the survey died a natural death because of the failure of the legislature to appropriate funds for its maintenance³. Thus ended the second state geological survey of Kansas.

The Hiatus 1866-1895

The Kansas Academy of Science and the State Geological Survey

Between 1866 and 1895 Kansas was without a state geological survey. Interest and work in geology in Kansas, however, did not cease with the demise of the survey. In the thirty years from 1866 to 1895 at least sixty-six individuals (Table 1) published 261 papers (Table 2) dealing with Kansas geology in more than thirty journals, transactions, proceedings and federal and state reports (Table 3). Of the 261 papers published 115 (or 44.1 percent) were in the field of paleontology; 76 (29.1 percent) were general in their scope; 37 (14.2 percent) dealt with stratigraphy; and 33 (12.6 percent) were of an economic nature (Table 2). Paleontological studies, largely vertebrate paleontology, were in the forefront in the years 1866 to 1878 and again from 1891 to 1895. These years from the golden era of vertebrate discoveries in which the Cretaceous chalk of western Kansas was made world famous by such paleontologists as E. D. Cope, J. Leidy, O. C. Marsh, S. W. Williston and C. H. Sternberg. In the field of paleobotany, L. Lesquereux is to be noted for his contributions dealing with fossil plant remains from the Dakota sandstone of Cretaceous age; and in the field of invertebrate paleontology F. B. Meek and A. H. Worthen are to be mentioned especially. Stratigraphic work was done largely by such men as F. W. Craigen, G. C. Broadhead, C. S. Prosser and Erasmus Haworth; while Robert Hay, B. F. Mudge, G. C. Swallow, and O. H. St. John busied themselves with all aspects of Kansas geology. Economic geology was of minor importance but was studied especially from 1883 on. It should be emphasized that most of the work done was by men independent of official state or federal geological surveys, men like who Mudge and Sternburg were for the most part associated with colleges, universities or museums and, for part of their careers, were solely independent

collectors and investigators. Perhaps of greatest interest to students of Kansas geology during these years of no state geological survey was the appearance of the first state geological map of Kansas prepared by B. F. Mudge (Fig.). This map accompanied Mudge's report on the "Geology of Kansas" published in 1875 in the Fourth Annual Report of the State Board of Agriculture (p. 127). A revised Geological map of the state, also by Mudge, was published in 1878 in the First Biennial Report of the State Board of Agriculture (p. 47) (1877-'78). A third geological map of Kansas was published in 1883 by O. H. St. John in the Third Biennial Report of the State Board of Agriculture (p. 575) (1881-'82). The first geological map of Kansas to be published in any of the Survey publications was the one by Haworth in Volumn I. plate 31, published in 1896. This map, although labeled "Preliminary" was somewhat different from S. W. Williston's geologic map of Kansas published in the Kansas University Quarterly in 1895 (Williston, 1895, III, 216). Several other geologic maps appeared in Survey publications since 1895 but all were of small size and none showed the details depicted on the large-size geologic map of the state first published in 1937 and revised in 1964.

The Kansas State Board of Agriculture passed and approved a resolution on January 8, 1873 to have on its staff a geologist as well as an entomologist and botanist. B. F. Mudge was appointed to the position of geologist and he held it until the time of his death of November 21, 1879. Following Mudge were Snow, St. John, Hay, Prosser and Sharp and, since 1896, Haworth, Grimsley and Moore (Table 4). Like the State Board of Agriculture, the Kansas Academy of Science had a number of commissions, including geology, in its organization. Mudge headed the commission on geology from its inception in 1872 to 1879.

At various times, H. C. Hovey, C. K. Jones and M. V. B. Knox assisted Mudge.

The duties of the commission were to make a collection of Kansas rocks, minerals and fossils, display them in the State House and report the progress made in geology during each year at the annual meeting of the Academy.

Table 1 Authors and number of papers published by each on Kansas Geology between 1866 and 1895

<u>Author</u>	<u>Number of papers</u>	<u>Field*</u>	<u>Author</u>	<u>Number of papers</u>	<u>Field*</u>
Cope, E. D.	36	Paleontology	Wooster, L. C.	4	General
Hay, R.	28	general	Case, E. C.	3	General
Haworth, E.	21	stratigraphy	Kunz, G. F.	3	General
Cragin, F. W.	19	Stratigraphy	Leidy, J.	3	Paleontology
Mudge, B. F.	15	General	Prosser, C. S.	3	Stratigraphy
Williston, S.	15	Paleontology	St. John, O. H.	3	General
March, O. C.	9	Paleontology	Ward, L. F.	3	Paleontology
Bailey, E. H. S.	9	Economic	White, C. A.	3	Paleontology
Snow, F. H.	7	Paleontology	Worthen, A. H.	3	Paleontology
Broadhead, G.	6	Stratigraphy	Case, T. S.	2	Economic
Lesquereux, L.	5	Paleontology	Hill, R. T.	2	General
Meek, F. B.	4	Paleontology	Knox, M. V. B.	2	General
Patrick, G. E.	4	Economic	Parker, D.	2	General
Sternberg, C. H.	4	Paleontology	Savage, J.	2	General
Swallow, G. C.	4	General	Miscellaneous one each	37	

* For the purpose of this paper authors are classified by field on the basis of the papers they published between 1866 and 1895

Table 2 Papers pertaining to Kansas geology published between 1866 and 1895

<u>Year</u>	<u>Total</u>	<u>Paleontology</u>	<u>General</u>	<u>Stratigraphic</u>	<u>Economic</u>
1866	4	3	1	0	0
1867	1	0	0	1	0
1868	3	1	2	0	0
1869	3	3	0	0	0
1870	6	6	0	0	0
1871	11	9	2	0	0
1872	13	10	0	2	1
1873	7	7	0	0	0
1874	5	2	1	1	1
1875	5	3	1	0	0
1876	8	5	3	0	0
1877	9	2	4	0	3
1878	8	6	1	0	1
1879	2	0	2	0	0
1880	2	1	1	0	0
1881	9	2	4	3	0
1882	5	1	1	3	0
1883	10	5	4	0	1
1884	7	2	2	1	2
1885	12	2	8 ⁷	1	2
1886	2	1	1	0	0
1887	12	2	6	2	2
1888	5	1	1	1	2
1889	13	2	4	2	5
1890	21	5	8	3	5
1891	11	4	4	2	1
1892	10	7	3	0	0
1893	15	5	6	1	3
1894	21	10	5	1	0
1895	21	8	2	8	3
1896-1895	261	115	76	37	33
Percent	100	44.1	29.1	14.2	12.6

Table 3 Journals, institutions and organizations publishing material on Kansas geology between 1866 and 1895, with number of articles published.

	<u>Number of Articles</u>
<u>Kansas Academy of Science</u>	62
<u>American Journal of Science</u>	28
<u>Kansas University Quarterly</u>	24
<u>U. S. Geological Survey</u>	18
<u>American Geologist</u>	15
<u>Kansas City Review of Science</u>	15
American Philosophical Society	14
<u>Science</u>	12
Kansas State Board of Agriculture	11
Philadelphia Academy of Natural Science	9
<u>American Naturalist</u>	7
Washburn College, Laboratory of Natural History	4
U. S. National Museum	3
St. Louis Academy of Science	3
American Associations Advancement of Science	3
<u>Paleontographica</u>	3
<u>Paleontology</u>	3
<u>Western Review of Science</u>	2
Illinois Geological Survey	2
Foreign publications	2
Miscellaneous publications	18

Table 4 Geologists for the Kansas State Board of Agriculture

1873-1879	B. F. Mudge
1880-1882	F. H. Snow
1883-1886	O. H. St John
1887-1892	O. H. [^] St. John and Robert Hay
1893-1894	Robert Hay and Chas. S. Prosser
1895	Robert Hay and S. Z. Sharp
1896-1897	S. Z. Sharp and Erasmus Haworth
1898-1904	Erasmus Haworth and G. P. Grimsley
1905-1917	Erasmus Haworth
1918-1950	Raymond C. Moore
1951-1964	None listed

(delete?)
Table 4 Geologists for the Kansas State Board of Agriculture)

Sixty-two of the 261 papers dealing with Kansas geology published between 1866 and 1895 appeared in the Transactions of the Kansas Academy of Science which, with the reports of the Kansas State Board of Agriculture and later the Kansas University Quarterly, constituted unofficially the state's geological publications. To the Kansas Academy of Science must be given the chief credit for keeping alive the agitation for a state geological survey. The Academy was founded on September 1, 1868 in the College building of Lincoln College (later Washburn Municipal University), Topeka (Schoewe, 1938, p. 399; 1963, p. 64). The purpose of the Academy was not only to secure advantages arising from association in scientific pursuits but also to give a more systematic direction to scientific research in the state (Parker, 1872, p. 4-5). Mudge, who at that time was on the staff of Kansas State Agricultural College, was the first president of the newly formed science society initially called the Kansas Natural History Society. A second charter member was Major Frederick Hawn (Taft, 1953, p. 293), assistant geologist under Mudge in 1864 and Swallow in 1865. It is not surprising, with such men as Mudge, Hawn and others in the organization, that the Academy was much interested in the establishment of a geological survey for Kansas. Indeed, it became the first major project of the Academy. As early as 1873, at the sixth annual meeting of the Academy secretary John D. Parker reported that the need for a more thorough, scientific survey of the state was being felt in various ways by the people of Kansas; and that a competent engineer should be employed to determine what natural resources might be available and their practical uses. The project, Parker believed "would result in an immense saving to the State" (Parker, 1873, p. 68). Although the name "geological survey," was not mentioned in the report,

it is certain that the geological survey was meant. At the seventh annual meeting of the Academy in 1874, Professor Mudge read a paper entitled "A Geological Survey of Kansas" (Mudge, 1874, p. 101-102). Mudge directed special attention to the economic importance of a geological survey. The following year the Academy appointed a committee, consisting of Professors W. K. Kedzie, M. V. B. Knox and Mudge, to draft resolutions for presentation to the legislature regarding the necessity of a geological survey of the state. The committee's report, which was unanimously adopted by the Academy and given to the Executive Committee of the Academy and to the State Board of Agriculture for joint consideration, was as follows:

It is now notoriously the fact that tons of choice minerals and fossils of Kansas are being shipped by collectors to the cabinets of eastern universities.

It is exceedingly important for the educational and scientific interests of the State that these valuable specimens should be detained in the cabinets of the State.

There is also a constantly increasing demand for more accurate and intelligent information as to coal, gypsum, salt and other resources of the State.

It is also well known that much money has been wasted in this State, in useless mining enterprises, which might have been saved by proper geological knowledge.

Therefore,

Resolved, 1st, That in the opinion of the Academy, a thorough geological survey of the State is imperatively needed.

2nd. This survey is necessary to develop fully the coal, salt, gypsum, lead, zinc, building stone, ochre and other resources of the State.

3rd. That such a survey should also include a thorough investigation of the rain-fall, spring and river system and general water supply of the State.

4th. That the material already accumulated by this Academy, including lists of plants, birds, minerals and insects of the State, will be gladly contributed to this work.

5th. That not only would such a survey place us on an equality with the more advanced States of the Union, but must prove for the State a most profitable monetary investment.

In 1876 the Academy drafted a resolution recommending a geological survey. Special emphasis was directed to coal which was being mined and which presumably

was making a considerable impact upon the economic wealth of the State. It was felt that "a careful survey of (the) coal formations would tend to fix more definitely the boundary line between our fertile coal measures and those that are barren."

Among the scientists, one of the chief reasons for wanting a state geological survey was the fact that considerable money was being wasted in the search for minerals, money which could have easily supported a geological survey. In 1881 Robert Hay read a paper before the Academy entitled "The Igneous Rocks of Kansas". In the paper, which was concerned with igneous and metamorphic rocks occurring in southern Woodson county, Hay made reference to the reported occurrence of silver and its mining in 1877. The futile search for silver led Hay to write: "If our State was thoroughly surveyed geologically, local reports could be investigated by a competent official before time and money were wasted in useless enterprises, and very probably knowledge would be obtained that could direct capital into useful and remunerative undertakings" (Hay, 1883, p. 18). Snow (1889, p. 39-42) voiced the same sentiments in his paper "The Logan County Nickel Mines" read before the Academy in 1888 at Leavenworth. In this paper Snow refers to the Woodson County silver episode and the futile expenditures of thousands of dollars. Concerning the supposed occurrence of nickel in Logan County, Snow wrote that in less than two weeks since the first announcement of the nickel discovery, hundreds of people had flocked to the metal area and had staked off mining claims covering more than four hundred acres of ground. Offers to purchase mining claims had soared as high as \$20,000 for two of the best claims and others less promising for as much as five hundred dollars for a half-share in a claim, all of which were rejected. Even though progress in obtaining a geological survey was slow and the legislature failed to provide

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for such surveys, curiously enough much interest in geology and a survey prevailed. The Legislature itself was geologically-minded, for in 1876 it passed a law requiring that in order to hold the highest grade of certificate, teachers of district schools should, by examination, show that they had ^{at} least an elementary knowledge of geology. Although this requirement had been repealed by 1885 it did give some impetus to geological enthusiasm and paleontological collecting began in many schools. At the request of state Superintendent of Schools John Fraser, Professor W. K. Kedzie of the State Agricultural College prepared a small book, entitled Elements of Agricultural Geology, for use in the schools of Kansas. The book, published in 1887, was based mainly on the reports of Professor Mudge (Hay and Thompson, 1887, p. 50). The text contained a geological map of Kansas which apparently was a modification of Mudge's geological map (Adams, 1903, p. 19).

In discussing "Is a Geological Survey of the State a Necessity[?]", Dr. R. J. Brown, retiring president of the Academy, in 1884 stated some of the reasons why repeated efforts of the Academy had been unsuccessful in influencing the legislature to establish a survey. According to Brown (1885, p. 50) a large number of the legislators were favorably inclined towards a geological survey but were of the opinion that a railroad bill, which was before them for consideration, should pass first. Some were against the survey because they thought it would cost too much and that the state could not afford it. Others doubted the value of a geological survey. Still others were of the opinion that it was a scheme merely to "pay the expenses of someone for collecting old bones and minerals that are found scattered over the prairies." Another group looked upon a geological survey simply as a topographical project related only to surface features and having little or nothing to do with anything found below the

surface.

The Chief obstacle in securing a geological survey for Kansas was, according to Brown, the fact that the people in general did not understand what a geological survey was and the benefits that would be derived from it. He was convinced that if the people once properly understood the value and nature of a geological survey that there would be no difficulty in securing appropriations for it. In preparing his presidential address Brown wrote to each of the states, seeking to ascertain whether they had a geological survey, when they were first established, their initial and subsequent appropriations, what practical benefit may have been derived from the survey, and to mention some of the industries which owed their origin and success to the geological survey. In summing up the twenty-nine replies received, Brown concluded that the most prosperous states were those where a thorough and systematic survey had been made. Their growth and prosperity, according to Brown, started at the time the surveys began to function and every state since that time had been amply remunerated for their outlay. Brown estimated that the cost of a state geological survey for Kansas for a period of ten years would probably be less than \$100,000, or \$10,000 a year. (Brown, 51-6)

Confusion, apparently, was in the minds of the early promoters of a survey and also among the legislators in regard to the length of time it would take to make a thorough geological investigation of the state and just what should be included in the function of such a survey. The Mudge survey of Kansas for 1864 was for one year only. The Swallow survey for 1865, although established without time limits, became inoperative at the end of that year for lack of appropriations. Whether the legislature was disappointed in the amount of work accomplished or whether it felt no practical

results were obtained or whether it was too expensive, is not known. Brown apparently considered ten years as the time required to complete a thorough survey if his statement that "less than \$100,000 during the next ten years will be sufficient to cover the expense" has any significance. Then too, just how much would the survey undertake? Brown was of the opinion that

"It comprises the study of everything below the surface. . . . Also, the botany of the State, showing distribution of the timber and vegetable growth indigenous to the State. Water power on all the rivers and streams, and the fall from various points, with such information as will enable everyone to understand their availability as water power for manufacturing purposes. . . . An examination of the character of the soil from all of the counties in the State, with an analysis of the same, indicating the soil suitable for the growth of various agricultural productions, in such a way as to be of practical benefit to the farmer. Rainfall and temperature should be accurately obtained. Considerable attention would be given to the eradication and means of the destruction of insects that are injurious to fruit and fruit trees, and prey on the products of the soil. . . . County maps should be made, giving a full history of the resources of the county. . . . All these come within the range of a geological survey, and properly belong to it." (Brown, 1885, p. 50).

In connection with the functions of the survey such as those outlined by Brown, it will be recalled that they were in keeping with those advocated by Swallow and also incorporated in the first two geological survey laws.

The value of topographic maps as related to geological investigations and for other purposes was recognized early by the scientists in the state. Topographic mapping by the United States Geological Survey, Topographic Branch in Kansas, started in 1884 and was well underway by 1893. A. H. Thompson, president of the Kansas Academy of Science in 1883, was especially interested in a topographic survey of the state and in particular advocated that maps be made on a larger scale than had been used on the maps for the eastern one-third of the State. Thompson wanted the legislature to appropriate funds

so that the state could cooperate with the federal government in making topographic maps on the scale of one inch to the mile instead of one inch to four miles, which could not show the details that Thompson thought should be depicted. In connection with the topographic mapping project Thompson addressed the Academy at its 1885 meeting on the topic "The Relation of a State Geological Survey to the Work of the National Survey." In the paper he reemphasized the need for a geological survey by saying

It was explained (in a letter written by Thompson to the United States Geological Survey) that we (the Academy) had been hammering away at the matter of getting a bill passed by the Legislature for a State Geological Survey for some years; that the people were in need of such a scientific work, that our resources might be developed, and the wasteful expenditure of capital in the blind search for minerals be avoided; that there was a great interest in the matter, as manifested by the numerous schemes which had been before the Legislature for the purpose, but that we had been unable to accomplish anything as yet. . . . There is now enough capital being thrown away in any one year in the blind search for coal, iron, zinc and other minerals to pay for a good geological survey in connection with the national work. (pp. 9 & 12).

Thompson cited the fact that "the city of Topeka has voted \$15,000 for the purpose of boring a shaft to ascertain if a paying vein of coal does not underlie the city somewhere in the bowels of the earth." According to Thompson, the search for the coal at Topeka was apparently not based upon the geological advice which a survey, had it been in existence, might have offered, but was based on a blind guess that coal surely was to be found if an experimental boring were to be made and "if the money holds out to go deep enough." Thompson concluded by saying that "capital is being wasted everywhere in the State"--money which easily could have financed a geological survey (p. 12). The persistence and determination to establish a survey is well indicated in the closing paragraph of Thompson's retiring presidential address in 1883, when he said

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"In the furtherance of our work one thing remains for us to accomplish before our honor and dignity shall be complete, and that is the geological and scientific survey of the State. That is one main object of our existence, and toward its accomplishment we must labor continuously until success shall crown our efforts, as it is certain to do. We must agitate the subject in season and out of season, until we obtain final victory. It is a duty we owe to ourselves, to the State, and to science" (Thompson, 1885, p. 16).

In the following year Dr. R. J. Brown read as his presidential address, "Is a Geological Survey of the State a Necessity?". The addresses of these two retiring presidents of the Academy resulted in the appointment of a committee on securing a state geological survey. At the 1885 meeting this committee (Thompson, 1887, p. 3) reported that "strenuous efforts were made to secure the passage of a bill providing for a geological survey of the State, by the last Legislature; but their efforts were unsuccessful, although there was much interest manifested in the subject. We should recommend that the effort be continued at the next extra session. There is a popular demand for the work, as well as an economic necessity. Detailed report, copies of bills, circulars, etc., have been deposited with the Secretary." Again in 1888, Robert Hay, in his lecture given before the Academy on "The Geology of Kansas" pleaded for a geological survey: "We may express the desire that this audience will use means to influence legislators to cause a survey to be made of this State, which will aid in developing our resources, and help to bring scientific problems to a correct solution" (Hay, 1889, p. 37).

State Board of Agriculture and the State Geological Survey

The Kansas Academy of Science was not alone in agitating for a geological survey. On July 27, 1878, H. C. St. Clair presented a resolution to the Kansas State Board of Agriculture in regard to the establishment of a survey. The resolution

which was adopted read as follows:

"Whereas, no thorough geological survey of the State of Kansas having been made, that of 1864 by Prof. B. F. Mudge and that of Prof. G. C. Swallow, in 1865, not being entitled to even the name of preliminary surveys, but merely reconnaissances of Eastern Kansas; and

"whereas, it is the sense of this Board that a thorough survey of the State would inure to the benefit of agriculture, manufacturers, etc.; therefore,

"resolved, That the next Legislature be respectfully requested to give the subject of a State Geological Survey, careful thought and consideration, and, if deemed advisable by said body, to provide for such a survey and a report of the same, accompanied with maps, charts, diagrams and engravings, illustrative of physical features, kinds of soils, mines, their extent and value, the fauna and flora, and of such other subjects as may come within the purview of such survey." (1878, p. 27).

Again in January, 1884 the Board of Agriculture offered a resolution which was adopted in behalf of a state geological survey (Popenoe, 1885, p. 489). Approximately six months later, on June 25th, William Sims, secretary of the Board said:

"Recognizing the importance of correct information as to geology and topography of the country, and feeling that no adequate provision for a thorough investigation of these features of our State are likely to be made at an early day, I beg leave very respectfully to recommend that, to the extent of the means at your command applicable to such a purpose, you authorize investigation of these subjects, and the publication in your forthcoming Biennial Report of such authentic information relating thereto as we may be able to secure. Direction as to the scope and general character of reports desired from the officers of the Board by appointment, for publication in the report under consideration, is respectfully solicited" (Sims, 1885, pp. 491-492).

Sims thereupon was instructed to prosecute the geological work heretofore undertaken, as far as means applicable to such purposes would allow. The Board went on record again as favoring a geological survey at its meeting on January 16, 1885, when its committee on resolutions resolved that

"Believing the State depends much upon its mineral development, we most respectfully request the Legislature to take into consideration and pass a law which will provide for a thorough geological survey of the State, so that its mineral resources may be accurately known, and investigations as to the probable water supply be scientifically made, and provide for the necessary expense of making the same." (Jenkins, 1887, p. 82)

Whether further attempts to influence the legislature to provide for a survey were made is not revealed in the proceedings of the State Board of Agriculture subsequent to 1885. The impact of the agitation by the Academy, the State Board of Agriculture and undoubtedly by various members of the legislature throughout these years is reflected by the numerous bills that were introduced favoring a state geological survey at almost every legislative session.

Further Recommendations by the Governors

The importance of a state geological survey for the development of Kansas was stressed in 1881 by Governor John P. St. John in his opening address to the State Legislature:

"I am of the opinion that the time has arrived when a comprehensive and thorough geological survey of our State should be instituted. The benefits to be derived from such a survey are so apparent that it is not deemed necessary to more than allude to some of them here.

In reference to the geology of the State, so little is known of the location of our coal fields that both capital and labor invested in mining enterprises are confined to localities where the existence and extent of coal beds is well known. Men hesitate to invest either capital or labor in an unexplored field, when there has been neither actual development nor scientific research to serve as a guide.

The importance of our manufacturing interests, as well as the question of fuel, demands that steps be taken at once to secure all information possible touching the coal deposits throughout the State. We are also in need of more exact information in regard to the extent and character of the lead and zinc ore deposits of the State, a careful examination of which undoubtedly will furnish most desirable practical results.

In the western part of the State a vast field invites systematic explorations, and it is very important that all the facts bearing on the coal, salt, gypsum, and other mineral resources of that region, should be made known. It is unmistakably the object of a geological survey to furnish concise and reliable information in reference to all these matters. While we may confidently anticipate the economic results which a scientific survey will certainly afford us, there are other considerations in this connection which every intelligent citizen will appreciate, and that is, the value it will have as a contribution to the sum of human knowledge" (House Jour., 1881, p. 62).

In response to Governor St. John's message, House Bill No. 174, "an act authorizing and providing for a geological survey of the State of Kansas and making appropriations for the same," was introduced into the House of Representatives. The Bill came up for second reading and then was referred by the Ways and Means Committee to the Committee on Mines and Mining "for their consideration on the subject-matter therein, other than that which relates to an appropriation." *The*

Committee on Means & Merit recommended that the bill pass but that first it be sent to the Joint Committee on Ways & Means for considering the question of an appropriation.

The Ways and Means Committee later recommended that the bill be rejected "for the reason that the expenditures required to properly carry out the provisions of this act and secure to the State a reliable and valued survey are such as the Joint Committee deem inexpedient to incur at this time^U. Apparently the committee's judgment relative to the cost of the survey was based upon a letter received from former State Geologist G. C. Swallow in response to a telegram sent to him by Edward Russell of the committee.

Your telegram reached me last night, and I replied as I suppose you desired. "Can I organize Kansas Geological Survey?" you ask. Yes, I will assist you in putting the work through, if I can be of any use to you.

I think the geology of the soils can be thoroughly examined and the results worked up in five years, at an expense of \$10,000 a year, besides printing, engraving, etc. If botany and zoölogy are included, it will cost about \$2,000 a year more. (House Jour., 1881, p. 612-613).

House Bill No. 174 failed to pass as did House Bill No. 401 in 1881 and House Bill No. 353 in 1883. In 1885 Governor John Martin's address to the legislature called attention to the fact that the Kansas Academy of Science would memorialize the legislature in behalf of a state geological survey:

"This (the Kansas Academy of Science) is a useful organization, maintained at no expense to the State except the courtesy of having its reports published as a part of the biennial report of the State Board of Agriculture.

The Society will present for your consideration and action, the question of providing for a thorough geological survey of the State. It is urged that, in view of the rapid settlement of Kansas, this work is a necessity; that in other states such surveys have revealed material resources which have added largely to the outlets for the useful employment of labor and capital; and that the value of the knowledge disseminated by the reports of such surveys, in preventing useless expenditures of capital in visionary enterprises, is equally great. It should not be forgotten, however, that a survey of this character, if properly conducted, will be very expensive; and that if it is not thoroughly prosecuted, by the most competent men, it is worthless^U. (House Jour., 1885, p. 147-148).

It appears that Governor Martin was not enthusiastic for the establishment of a state geological survey, for in his message he cited the action of the Kansas

Academy of Science rather than stating his own desires. Furthermore, his remarks concerning the cost of conducting the survey certainly were of no aid in promoting such legislation. House Bill No. 99, "an act providing for a geological and mineralogical survey of the State," was introduced in the House but failed to pass, as did a substitute bill. In 1886 the matter of geological survey again came up for consideration. This time, however, a bill similar to the substitute bill for House Bill No. 99 of 1885 was passed. This bill, No. 54, called for

"An act to create a board of survey to conduct experiments to determine the existence of coal or other minerals and the practicability of securing artesian wells in the State of Kansas, and defining the duties of said board of Survey".

Although the Bill was passed it soon died because of lack of appropriations. House Bill No. 78 was "an act providing for the sale of school lands, the proceeds thereof to be appropriated for the purpose of carrying out House Bill No. 54. The failure of this bill to pass made the passage of House Bill No. 54 meaningless. It should be noted that House Bill No. 54 did not call for a state geological survey but created a "board of survey" to conduct certain specific experiments. In 1887, House Bill No. 189, "an act establishing a geological survey of Kansas, and defining the purpose and work thereof," and House Bill No. 173 similar to House Bill No. 54 of 1886 were introduced for consideration but both failed to pass.

University Geological Survey, 1895-1907
Haworth 1895-1907

The 1889 Kansas legislature, in making appropriations for the current expenses of the University of Kansas, included a provision that one of the functions of the University should be a geological survey. As far as is known, no definite steps were taken by the University to put the survey into operation until 1895 when the Board of Regents, by special enactment, declared the University Geological Survey organized with the Chancellor as its director ex-officio and consisting of three departments: Physical Geology and Mineralogy, Paleontology and Chemistry. Chancellor F. H. Snow, who automatically became director ex-officio of the Survey, (Table 5) appointed Erasmus Haworth, of the Department of Geology of the University, to head the Survey's Department of Physical Geology and Mineralogy, S. W. Williston, paleontologist in the Department of Geology, in charge of the Survey's Department of Paleontology; and Professor E. H. S. Bailey, head of the University's Department of Chemistry in charge of that branch of the Survey. When the University Geological Survey was organized neither Haworth, Williston nor Bailey was named state geologist. Each appointee headed his own department, supervised its projects and, in submitting reports for publication, each head wrote his own letter of transmittal and, with one exception, the preface for the report. According to Haworth (1896, p.6) the Board of Regents contemplated that each of the three survey departments would be responsible for the results and for the "degree of energy and zeal" with which the work was undertaken. Each department was expected to publish the results of its work from time to time. It was agreed that the first work to be accomplished was in the field of general stratigraphy, defining areal boundaries and related subjects.

Table 5 Chancellors of the University of Kansas, Ex-officio Directors of the Geological Survey.

Francis H. Snow	1895-1891
Frank Strong	1902-1920
Ernest H. Lindley	1920-1939
Deane W. Malott	1939-1951
John H. Nelson (acting chancellor)	July-August 1951
Franklin D. Murphy	1951-1960
W. Clarke Wescoe	1960-

On the basis of this decision Haworth's Department of Physical Geology and Mineralogy published the first three volumes or reports of the University Geological Survey.

It was not until 1903 that the title "State Geologist" was used for the first time listing the personnel of the Survey and in the signature of the writer of the letter of transmittal. Haworth used the title "State Geologist" for the first time in the Annual Bulletin on the Mineral Resources of Kansas, 1902, published in July, 1903, and again in Vol. VIII, Special Report on Lead and Zinc, published in 1904. Actual geological field work, although of a semi-official nature, started in 1893 under the direction of the Department of Physical Geology, two years before the Board of Regents officially established the Survey.

Three advanced University students, M. Z. Kirk, W. H. Piatt and C. E. McClung were appointed to do field work under the direct supervision of Haworth. For this work the students were to receive University credit. Haworth, in addition to directing the field work of the three students, spent considerable time studying the stratigraphy of the rocks in southeastern Kansas. In 1894 the work was continued and expanded with more men in the field, among whom were George I. Adams, Rev. John Bennett, John G. Hall and J. Z. Gilbert. As in 1893, most of the work done was in the making of stratigraphic sections along designated routes. In addition to stratigraphic studies, Rev. Bennett studied the invertebrate paleontology of the Coal Measures. In the summer of 1895 twelve men were in the field. Some of the field assistants, J. H. Patton, Walter Griffiths, B. L. Pampel, W. N. Logan, and W. R. Crane, were students from the University. George I. Adams, formerly of the University, was a graduate student at Princeton University, whereas others had no connection with the University but offered their services for the good of science.

Among these were Earl G. Swem of Delhi, New York, who studied glacial deposits of northeastern Kansas; Rev. Bennett, stratigrapher and paleontologist from Fort Scott; Professor E. B. Knerr of Midland College, Atchison; Dr. S. Z. Sharp, President of McPherson College, who devoted his time to the study of the Dakota formation; Professor J. H. Harnley also of McPherson College; and M. Z. Kirk who was assigned a special problem to study the salt deposits of the State. It is most remarkable that such an array of men were willing to study the geology of the state on their own when it is realized that no provision was made in the organization of the survey to compensate the assisting geologists for their services. In regard to the gratuitous service Haworth said:

"Few, if any, instances can be found in the annals of America where so many able men have contributed so much of their time to the material development of their state. Our state as a whole is the gainer, but it should not forget their generous gift of time and ability" (Haworth, 1896, p. 4).

In outlining the objects and plans of the newly organized University Geological Survey, Haworth stated that a "full and complete" survey of the state was contemplated but that the work would by necessity proceed with relative slowness. The work was expected to be done by the "members of the University faculty, their advanced students, and other individuals, citizens of the State or otherwise who would be willing to give their time and energies to the State a few months of the year in assisting to carry on investigations interesting and scientific in character, and valuable in many ways in their results." In regard to compensation Haworth added that their compensation would be "an increase in the knowledge of nature, an opportunity to study geology in the field, a medium of publication by means of which they may have their labors brought before the world, and a consciousness of having added a mite to the

'increase and dissemination of knowledge among men.'" (Haworth, 1896, p. 6).

The first two geological surveys under Mudge and Swallow were essentially of a reconnaissance nature. The University Geological Survey under Haworth, Williston and Bailey, on the other hand, served not only as the pioneer geological survey of Kansas but laid the groundwork for all subsequent geological work in the state up to the present time. Of the nine basic reports, two dealt with detailed stratigraphic studies, five were concerned with the economic resources of the state-- coal, gypsum, mineral waters, lead and zinc, and oil and gas--and two were in the field of paleontology, both vertebrate and invertebrate. In the stratigraphic and paleontologic volumes considerable emphasis was given to the Cretaceous of the eastern Kansas, although the first volume of the series was essentially restricted to the stratigraphy of the Mississippian, Pennsylvanian and Permian systems of the eastern part of the state. These nine volumes total 3,955 pages of basic geologic and paleontologic information. In addition, the six unnumbered bulletins, totalling 555 pages, added information on the mineral resources of the state to that presented in the more comprehensive volumes just cited. It is most remarkable that even though the many assistant geologists who worked for the survey received no compensation for their efforts except bare field expenses, so much was accomplished by the University Geological Survey in the early years on such a limited budget. The annual appropriations for the survey from 1897 to 1903 was only \$1,500 and from July 1903 to 1907 it was \$3,000. The entire total appropriations for the ten years amounted to only \$21,000.

The first reports of the University Geological Survey of Kansas were published as octavo volumes. Bulletins, according to Haworth, (1896, p. 8) were considered

an an "overflow publication" and were "unnecessary, because our University Quarterly (later to become the Science Bulletin), a regular publication, meets such requirements". At least seventy-four papers by members of the geological staff were published in the University Quarterly between 1893 and 1901, Haworth being responsible for eleven of them and Williston for twenty-six. From 1897 to 1903 the survey published yearly reports on the mineral resources of the state. These reports were issued under the caption Annual Bulletin on Mineral Resources of Kansas although no bulletin number was assigned to them. The first publication of the survey designated as a bulletin by assigning a number was issued in 1913 when Haworth published his Special report on well waters. Bulletin 2, On Crystalline Rocks in Kansas, also by Haworth, was published in 1915. Both of these were issued under the name of the University Geological Survey, although officially the name of the survey had been changed in 1907 to the State Geological Survey of Kansas. The first two bulletins were considered emergency reports, reports that needed to be brought to the attention of the citizens of the state immediately because of drought conditions and for the purpose of restoring confidence in drilling for oil. The reports were not considered to contain basic or new geologic information, hence they were "overflow publication." Haworth, in his letter of transmittal, referred to the second bulletin as "this little report." Therefore they were published as bulletins rather than as octavo volumes. (p. 3).

Up to 1901 there were no restrictions upon the number and length of reports published by the Survey in any fiscal year. In 1901 and subsequent years up to 1907, however, the law stipulated that the Survey could publish but two reports in a fiscal year, one report in pamphlet form not to exceed 125 pages in length and a second report, an octavo volume, of no more than 450 pages, exclusive of illustrations. The pamphlet

report was officially to be called Annual Report on the Mineral Resources of Kansas and was to contain mainly statistical data on mineral production in the state. The second type of report, the octavo volume, was to consist of more extended studies on subjects or areas. According to the law of 1905, the state geologist was directed specifically to prepare for publication a special report on oil and gas, (published as Vol. IX, 1908). The report was to include a complete description of the oil and gas fields of Kansas, containing all desirable information regarding their geography, geology, production, quality and market valuations, and also drawings necessary for the production of a lithographic geological map of the entire state of Kansas. Except for the statistical reports on the mineral resources of Kansas, the law of 1905 stipulated for the first time a specific report to be prepared and published by the survey as well as the preparation and publication of a geological map of Kansas. Furthermore the law also prescribed the exact number of copies (five thousand) of each report that could be printed and distributed and the manner in which the reports were to be bound. The annual reports on the mineral resources were to be paper bound, whereas the octavo volumes were to be bound in cloth. Not only did the law state the number of copies that could be printed but it also instructed the state printer how they were to be distributed; one thousand copies of each report were to be delivered to the speaker of the House of Representatives for distribution to the members of the House; five hundred copies were assigned to the lieutenant-governor for distribution to members of the Senate; sixty copies were to be delivered to the State Historical Society, as prescribed by law; and the remaining 3,440 copies were to be delivered to the chancellor of the University of Kansas, and by him sent free of charge to citizens of Kansas who asked for them or given in exchange for

geological and scientific publications of the world. A statute of 1907 reduced the number of copies to the speaker of the House of Representatives and to the lieutenant-governor by one-half, the State Historical Society receiving its sixty copies, and the chancellor the remaining 4,190 copies. The law also did not specifically call for an annual statistical report although it did limit the Survey to publish no more than one such report and one more elaborate report in a fiscal year.

State Geological Survey of Kansas

Haworth 1907-1915

As indicated elsewhere the name of the Survey was changed in 1907 from the University Geological Survey to the State Geological Survey of Kansas. During the period from 1907 to 1915, Volume IX, Special Report on Oil and Gas by Haworth and others was published. This volume of 586 pages was issued under the old name, University Geological Survey, as were the first two numbered Bulletins, although officially the Survey had become the State Geological Survey of Kansas.

In 1915 Haworth resigned his position as state geologist and director of the Survey and he and his son Huntsman became consulting geologists. Haworth, however, maintained his relation with the Department of Geology at the University as professor of geology and head of the Department until 1920.

Until 1909 the Survey was housed in old Snow Hall (Fig.) which was located west of Fraser Hall and north of Watson Library. In 1909 the Survey moved to the new geology and mining building, Haworth Hall (Fig.) where it remained until 1945.

William H. Twenhofel, 1915-1916

Dr. W. H. Twenhofel, professor of geology at the University, succeeded Dr. Haworth as state geologist and director of the Survey in 1915. He held the position, however, for only one year; in 1916 he resigned to accept a professorship at the University of Wisconsin. No publications by the survey appeared during Twenhofel's tenure, although work for future publications was underway.

Raymond C. Moore, 1916-1917

The modern State Geological Survey of Kansas had its beginning with the Haworth regime but it was not until 1916, when Dr. Raymond C. Moore became state geologist and director, that the Survey became an effective, dynamic force in advancing the geologic knowledge of Kansas and began to be an important aid in the economic development of the state. The first report published under Moore's direction appeared in 1917. This report, Bulletin No. 3, was entitled Oil and Gas Resources of Kansas and was authored by Moore and Winthrop P. Haynes. It was the first report to be published ~~in~~ the survey's new name of State Geological Survey of Kansas. The report consisted of 391 pages and contained all the information then known concerning oil and gas occurrences in the state, together with many important topics including a general discussion of the properties of oil and gas, general oil and gas geology, production, the general stratigraphy of the state, physical and chemical properties of Kansas petroleum and known data with maps for all Kansas counties. The bulletin soon became one of the most sought-for reports dealing with the state and was regarded as the "bible" for Kansas oil and gas. The demand for this work, because of the rapidly growing interest and importance of Kansas as an oil and gas state, soon resulted in exhausting the Survey's available free supply of the bulletin. By 1920 the bulletin was out of print and second-hand copies commanded high prices on the open market.

Raymond C. Moore - Kenneth K. Landes, 1927-1941

By 1927 the duties of the state geologist called for an assistant state geologist of the Survey. First appointee to this position was Dr. Kenneth K. Landes, a newcomer to the Department of Geology at the University. Later, in 1937, Dr. Landes became co-state geologist with Dr. Moore and assistant director of the Survey. Dr. Landes served in these capacities until 1941 when he resigned to assume the chairmanship of the Department of Geology at the University of Michigan.

Until 1930, all of the publications of the Survey with few exceptions were related to economic aspects, primarily directed to the oil and gas resources of the state. Salt, volcanic ash and clay and shale resources, however, were not overlooked. Bulletins dealing with the geology of the various counties soon followed as did subsurface studies and works on paleontology and stratigraphic classifications. In 1937 the Survey revived its long abandoned volume series by issuing Volume X, Late Paleozoic Pelecypods, Part 1, Pectinacea, by Norman D. Newell. After 1940 bulletins dealing with ground-water resources increased in number and in importance. Bulletins dealing with the state's coal resources started in 1938. Reports on oil and gas developments had their start in 1941 and have since appeared annually. Among the notable contributions made by the Survey during the Moore-Landes period was the publication in 1937 of the state's first large geologic map of Kansas in colors. This map, 40 x 51 inches on a scale of 1:500,000 (approximately eight miles to the inch), showed for the first time in considerable detail not only the geological systems represented in the state but also depicted the boundaries of the various series and groups of rocks as well as many individual rock formations. During the Moore-Landes administration the Survey published Bulletins 12 to 36 and also numbers 1 to 13 of the Mineral Resources Circulars.

Raymond C. Moore - John C. Frye, 1941-1945

After Dr. Landes' departure from Kansas, Dr. John C. Frye, a staff geologist of the U. S. Geological Survey, Groundwater Branch, was appointed assistant state geologist and assistant director of the Survey. From 1942 to 1945, Dr. Moore was on leave of absence in order to enter military service and Dr. Frye assumed the responsibility of directing the Survey.

An innovation in publishing reports was started in 1941 with the publication of a new series, Reports of Studies. The series consists of reports usually no more than one hundred printed pages length and not confined to any one topic. Although each part is published individually and independently of any other parts at various times during the year, all parts at the end of the year are assembled under one bulletin number and paged in continuous sequence. The first Report of Studies was issued in 1941 as Bulletin 38 and consisted of thirteen parts. During the 1941-1945 period the Survey also published Volume X, Part II, Late Paleozoic Pelecypods, Mytilacea by Norman D. Newell, Bulletins 37 to 60 including thirty-eight parts comprising Reports of Studies Bulletins 38, 41, 47, 52 and 60. The first large-size (31.5 x 45 inches) map, Kansas Mineral Resources in six colors, was also published during this period, as well as Oil and Gas Investigations, No. 1 Cross-Section chart.

John C. Frye - Raymond C. Moore, 1945-1954

In 1945 Dr. Frye became co-state geologist with Dr. Moore and also executive director of the Survey, thus relieving Dr. Moore of his time-consuming administrative duties. At the same time Dr. Moore was designated Research Director of the Survey.

In 1945 the survey moved from Haworth Hall (Fig.) and Hoch Auditorium (Fig.) to its new headquarters in Lindley Hall, (Fig.) also known as the Mineral Resources Building. During Dr. Frye's tenure as state geologist and executive director of the survey, Dr. Moore was on leave in 1949, serving as consultant to General Douglas McArthur in Japan and again in 1951-1952 as visiting professor of physical sciences, representing the Association of American Universities in the Netherlands. In 1954 Dr. Frye resigned to accept the position of state geologist and chief of the Illinois Geological Survey.

Reports published during the Frye-Moore administration included Volumes XI and XII, which treated the geology, mineral resources, and ground-water resources of Chase and Lyon counties respectively; and Bulletins 61 to 106 and 108 including sixty parts comprising nine Reports of Studies. In addition, all three editions of the Petroleum Industry in Kansas maps appeared. Also issued were the Kansas Pits and Quarries map and the second edition of the map of Kansas Mineral Resources. Oil and Gas Investigations, cross-sections and maps, numbers 2 to 12 were issued during the 1945-1954 period;

Although the Survey has always participated in public information and public relations activities, no formal Public Information and Education division was in existence until 1952. This division not only is responsible for general news releases and answering letters of a general informational nature but provides educational materials in the form of mineral and rock sets, maps and popularized geological literature for schools and individuals. The division also plans and arranges for staff members to participate in institutes and workshops for teachers of science (especially of earth science); provides judges for science fairs; arranges lecture-visits and tours for schools and youth groups;

and makes provision for Survey exhibits for display at national, regional and local organization meetings.

Frank C. Foley - William W. Hambleton, 1954-

Dr. Frank C. Foley of the Illinois Geological Survey succeeded Dr. Frye as state geologist and director of the survey. In 1957, Dr. Foley was also appointed chairman of the Department of Geology, which position he relinquished in 1963. In 1957 also, Dr. William W. Hambleton, Assistant Professor in the Department of Geology, was named assistant state geologist and assistant director of the Survey, a title he held until he was promoted to associate state geologist and associate director of the Survey in 1958. From August 31, 1959 to June 30, 1960, Dr. Hambleton was on leave to study geophysics at the Lamont Geological Observatory of Columbia University at Pallsade, New York. During the adademic year 1962-1963 he devoted one-half of his professional time as director of GEO-Study sponsored by the American Geological Institute. During Dr. Foley's leave for five months (beginning with November 1963), to make a reconnaissance of the ground-water resources of the Ivory Coast for the Agency for International Development, Dr. Hambleton served as acting state geologist and acting director of the State Geological Survey.

Since the Foley-Hambleton regime assumed the direction of the Survey, the Survey's list of publications include: Volumes XIII and CIV, dealing with the geology, mineral resources, and ground-water resources of Osage and Elk counties respectively (the last of the volume series to be published) and Bulletins 107 to 167 (excepting 108). including nine Reports of Studies of fifty-five parts. In addition the Survey issued a colored Map of Oil and Gas Pipelines and Industries in Kansas (40 x 54 inches) in 1964

and charts and maps, numbers 13 to 27, of the Oil and Gas Investigations series and a number of miscellaneous reports. The contents of the Survey's bulletins of this period follow closely those of the Moore-Frye and Frye-Moore administrations. Notable differences include: bulletins by the Geochemistry Division of the Survey; a revival (but again discontinued in 1960) of the annual reports on the Mineral Industry of Kansas prepared by the Economics and Coal Division (renamed the Mineral Resources Division); and a number of bulletins of a geophysical nature. A recent innovation is the use of the electronic computer and the training of the Survey staff with computer operations and techniques. Largely because of Dr. Hambleton's initiative, the Survey included in its organization a Geophysics Division with the result that several bulletins devoted to this field have thus far appeared, including Bulletin 137, Symposium on Geophysics in Kansas edited by Dr. Hambleton, A new emphasis on mineral resources is now underway.

Largely as a result of the Survey's participation in the Governor's Economic Development Committee Program, a 148-page sector report on Mineral and Water Resources was published in 1962. This far-reaching and comprehensive study was prepared by Survey staff members under the supervision and direction of Dr. Hambleton who served as a research consultant on the Governor's Economic Development Committee. As a result of this report, it became obvious to the Survey administrators that it was necessary for the Survey to engage in mineral-commodity processing and accordingly should be "committed to a program of product development, market analysis, and studies of trends in the area of mineral commodities." (Hambleton, 1962, p. 2-12). An inspection of the Activities of State Geological Survey of Kansas, Biennium ending June 30, 1963 (Muikenburg, 1963) (Special Distribution Publication No. 5) reveals that

the Survey has in progress numerous projects for the immediate years ahead. Not least in importance is the revised geologic map of the state replacing the geologic map of 1937. This map was released in June, 1964. In addition, an up-to-date third edition of the Kansas Mineral Resources map, replacing the second edition of 1951, is now in preparation. Also, greatest expansion of detailed topographic mapping (u.5 minute quadrangles) has taken place during the Foley-Hambleton administration.

Summary of Publications

Although first limited by statute to one octavo volume and one bulletin per year in 1864, restrictions on the number of reports soon were repealed and the Survey began to issue geological reports as rapidly as field work permitted. A summary of Survey publications from 1864 to the close of 1963 is herewith presented. It should be noted that in addition to those publications indicated in Table 6, the Survey has also issued "Miscellaneous Publications" most of which are not of a technical nature but are designed to disseminate general information. Attention is also directed to Bulletins 5, 6, (Parts I, V, VI), 7, 10, 11, 15, 16, 17 and 20 which carry no official date of publication and hence may cause some confusion in citing references or in documentation. Dates of these bulletins, however, are known from indirect sources and may be determined from the Survey's periodic official list of publications and which is herewith included in this report as Appendix A. Beginning with Bulletin 163 (1963), a new format for the series was inaugurated. Previous bulletins were 6.1 x 9 inches in size with printed matter 4.5 inches or 26.5 picas wide, whereas those printed on the new format are 6.7 x 9.7 inches in size with two printed columns, each 2.6 inches or 16 picas wide. Another innovation was the inclusion of foreign-language translations of abstracts of its publications -- French, German, and Spanish in addition to the customary English abstract.

Table 6

Summary of State Geological Survey of Kansas Publications
1864-1963

Administration	Period	Reports*	Vol.	Bulletins		Min. Resrs.		Oil & Gas Investigations	Maps† Other than Topographic
				Whole	Pts.**	Circulars	Ann. Rpts.		
Mudge	1864-65	First Annual	---						
Swallow	1865-66	Preliminary	---						
Haworth	1895-1915		1-9	1, 2			6**		
Twenhofel	1915-16		---	---					
Moore	1916-27		---	3-11	14				
Moore-Landes	1927-41		10, Pt. I	12-36	2	1-13			G
Moore-Frye	1941-45		10, Pt. II	37-60	38				MR
Frye-Moore	1945-54		11-12	61-106, 108	60			1-12	MR. P. Pt.
Foley-Hambleton	1954-		13-14	107, 109-167	52			13-27	OGP, G

* Discontinued series

** Number of parts or reports, not bulletin numbers

† G-Geologic; MR - Mineral Resources; P - Petroleum Industry; Pt. - Pit & Quarry;
OPG - Oil & Gas Pipelines and Industries

Miscellaneous or non-technical publications are not included in the table.

For a complete list of publications of the survey, see "List of Publications," issued May 1, 1964, herewith included in this report as Appendix A.

Financial History

Like most organizations, the State Geological Survey of Kansas had had its financial ups and downs (Fig.). The 1864-1865 survey had an appropriation of \$3,500 whereas the second or 1865-1866 survey received \$7,500 for its operation. Between 1890 and 1919 survey appropriations varied between \$1,500 and \$3,630. It is interesting to note in this connection that the laws of that time stated that "no portion of [the appropriation] shall be used for salary or compensation for any one who at the same time is drawing a salary from the state of Kansas" (Laws of Kansas 1903, p. 106).

The fiscal years 1919-1920 and 1920-1921 were outstanding. The appropriations suddenly soared from a mere \$3,360 to \$25,000 annually. The cause of this phenomenal increase is problematical, but it can easily be surmised that an important contributing factor was that Kansas was experiencing a great oil and gas boom and that the publication in 1917 of Moore and Hayne's bulletin 3, Oil and Gas Resources of Kansas, was showing its effects. Between 1921 and 1929 the Survey again experienced a slump; Appropriations did not exceed \$8,950 and reached a low of \$2,553 in 1922-23. Except for the 1933-35 period, when the appropriations amounted to \$10,000 annually, the period of increased financial support had set in. Appropriations amounted to \$40,000, the \$77,000, followed by 96,000. Beginning with the 1947-1948 bienium they never fell below \$137,000. By 1955 financial support had reached \$298,208 to be followed for the next two years by amounts in the 300,000 bracket, 400,000 in the succeeding two years, 500,000 in the following next two years, and 663,809 in 1963-64.

It is important to note that until 1941 all publications of the Survey were printed

on authorization of the legislature by the state printer at Topeka without cost to the Survey, thereby actually increasing the appropriations. In that year, however, the legislature repealed the law which required the state printer to furnish printing for the Survey. (Laws of Kansas, 1941). From that time on funds for the Survey were included in the University appropriations. In doing so, it was made possible for the Survey to have some of its printing done by plants other than that of the State Printer, for example the University of Kansas. Because of the Survey's cooperative program with the U.S. Geological Survey and other federal agencies an additional sum of non-state money, amounting to more than \$200,000, is devoted to geological work done in the state by federal agencies on a matching basis. Appropriations for the Survey since its beginning in 1864 up to the 1963-1964 period are presented in Table 7 and shown on a semi-logarithmic graph in Fig. ____.

TABLE 7

Appropriations for the Geological Survey, 1864-1964

1864-1865 . . . \$	3,500	1926-1927 . . . \$	7,700
1865-1866 . . .	7,500	1927-1928 . . .	3,500
1889-1890 . . .	No Survey	1928-1929 . . .	4,365
1890-1891 . . .	1,500	1929-1930 . . .	25,000
1891-1892 . . .	1,500	1930-1931 . . .	25,000
1892-1893 . . .	1,500	1931-1932 . . .	25,000
1893-1894 . . .	1,500	1932-1933 . . .	18,750
1894-1895 . . .	1,500	1933-1934 . . .	10,000
1895-1896 . . .	1,500	1934-1935 . . .	10,000
1896-1897 . . .	1,500	1935-1936 . . .	25,000
1897-1898 . . .	1,500	1936-1937 . . .	25,000
1898-1899 . . .	1,500	1937-1938 . . .	40,000
1899-1900 . . .	1,500	1938-1939 . . .	40,000
1900-1901 . . .	1,500	1939-1940 . . .	77,000
1901-1902 . . .	1,500	1940-1941 . . .	77,000
1902-1903 . . .	3,000	1941-1942 . . .	83,500
1903-1904 . . .	3,000	1942-1943 . . .	83,500
1904-1905 . . .	Data Missing	1943-1944 . . .	70,000
1905-1906 . . .	" "	1944-1945 . . .	70,000
1906-1907 . . .	" "	1945-1946 . . .	96,000
1907-1908 . . .	" "	1946-1947 . . .	96,200
1908-1909 . . .	" "	1947-1948 . . .	137,000
1909-1910 . . .	" "	1948-1949 . . .	137,000
1910-1911 . . .	" "	1949-1950 . . .	192,000
1911-1912 . . .	" "	1950-1951 . . .	198,000
1912-1913 . . .	" "	1951-1952 . . .	210,000
1913-1914 . . .	2,500	1952-1953 . . .	212,000
1914-1915 . . .	2,750	1953-1954 . . .	250,000
1915-1916 . . .	3,550	1954-1955 . . .	275,000
1916-1917 . . .	3,630	1955-1956 . . .	298,208
1917-1918 . . .	3,630	1956-1957 . . .	352,348
1918-1919 . . .	3,630	1957-1958 . . .	373,576
1919-1920 . . .	25,000	1958-1959 . . .	461,752
1920-1921 . . .	25,000	1959-1960 . . .	474,202
1921-1922 . . .	7,603	1960-1961 . . .	541,000
1922-1923 . . .	2,553	1961-1962 . . .	560,051
1923-1924 . . .	8,000	1962-1963 . . .	619,505
1924-1925 . . .	8,950	1963-1964 . . .	663,809
1925-1926 . . .	7,175	1964-1965 . . .	

Organization

The organizational structure of the 1864 and 1865 geological surveys was simple. In addition to the state geologist, the survey personnel included a chief assistant, a paleontologist, a chemist and meteorologist, a botanist, and a sanitary relations specialist. Likewise, the University of Kansas Geological Survey of 1895 consisted of only three main departments: physical geology and mineralogy, paleontology and chemistry, each department being headed by a scientist selected by the Chancellor of the University. The title of State Geologist was not officially recognized until 1903. Furthermore, it was not until 1940 that the Survey had definite divisions and departments, such as administration, stratigraphy, paleontology and areal geology, and others. As the Survey continued to grow and new techniques developed, the organizational plan was modified by the addition of new divisions and the renaming of older divisions. Essentially, however, the organization has undergone relatively little change since 1940. The organization of the State Geological Survey of Kansas as of March 1, 1964, the hundredth anniversary of the effective date of the Survey's origin, is presented in Table 8.

TABLE 8

Organization of the State Geological Survey of Kansas, March 1, 1964

Administration

- Chancellor of the University, ex-officio Director
- State Geologist and Director
- Associate State Geologist and Associate Director
- Principal Geologist
- Senior Geologist
- Secretary
- Clerk-typists

Advisory

- Mineral Industries Council

Basic Research

- Stratigraphy and Paleontology*
- Petrography, Mineralogy, and X-ray*
- Geophysics*
- Geochemistry*

Mineral Resources*

- Oil and Gas*
 - Well Sample Library, Wichita
- Mineral Resources*
- Ceramics*

Public Information and Education*

- Publications, Records, Editor and Drafting Department*
- Cooperative studies with U.S. Geological Survey
 - Ground-water Resources*
 - Western Kansas Field Office, Garden City
- Mineral Fuels*
- Topographic Mapping

Cooperative studies with U.S. Bureau of Mines

Cooperating agencies

- Kansas State Board of Agriculture
- Kansas State Board of Health, Division of Sanitation
- State Corporation Commission, Conservation Division
- State Water Resources Board

Cooperative research arrangements

Stanford University
University of California at Los Angeles
University of Utah
Rice Institute
University of Texas

Iowa University
New York University
Columbia University, New York
University of Kansas

* Divisions

Mineral Industries Council

In 1937 a Mineral Industries Council consisting of twelve men associated with the various segments of mineral production and manufacture of mineral commodities was appointed by the Chancellor of the University on the recommendation of the state geologist and director of the Survey. This council meets at least once each year for the purpose of advising the administrative officers of the Survey in matters pertaining to possible research to be undertaken by the Survey relating to industrial and agricultural needs. Council members serve four-year terms with three terms expiring each year but subject to reappointment. The importance of the Mineral Industries Council to the Survey is best appreciated by the fact that since its January, 1964 meeting, there have been annual two-day sessions annually, instead of the one-day meetings prior to that time.

Branch and Regional Offices

Southeastern Kansas Field Office, Pittsburg

Until 1963 there had been three branch or regional offices of the State Geological Survey. The oldest one of these, now no longer in existence, was the Southeastern Kansas Field Office located at Pittsburg. This general office was housed in the Manual Arts building of Kansas State College. The office was established in 1937 and was headed by Dr. George Abernathy who, until his death in 1948, served the southeastern part of the state in general geological investigations. Dr. Abernathy was succeeded in August, 1949, by Allison Hornbaker who was in charge of the office until January, 1958, when he was transferred to the Lawrence office. Next in charge was Douglas Beene who in 1963 was moved to the Lawrence office after the closing of the Pittsburg branch.

Well Sample Library, Wichita

As early as 1938, the State Geological Survey established and maintained a reference library and laboratory of sample oil well cuttings. It has grown to one of the largest well sample libraries in the Mid-Continent Field. At first it was located in Lawrence and later it was moved to 139 North Mead Street in the downtown industrial area of Wichita. On October 30, 1959, the Survey became the owner of a newly constructed building at 4150 West Monroe Street in Wichita. The University of Kansas - State Geological Survey Well Sample Library, as the library is known, is a gift to the Survey by more than one hundred oil and gas companies operating in the state and by friends of the Survey. The library houses in its oil and gas files 150,000 driller's logs, 45,000 electric and radio-activity logs, and well sample cuttings from more than 75,000 wells.

All of these are made available to the public on a library-loan basis or are for ready reference and study in the new building. Well sample cuttings have been donated by individual oil and gas operators, major oil companies and the Kansas Well Log Bureau sponsored by the Kansas Geological Society of Wichita. The office is staffed by a geologist and several assistants. The Well Sample Library is an off-shoot of the Oil and Gas Division of the Lawrence office, under whose supervision the Wichita office operates.

The Wichita Branch now also serves as a distribution center for Survey bulletins and other information especially related to central Kansas.

Garden City Branch

A branch office under the supervision of the Ground-Water Division was established in 1959 at Garden City in Finney County. The Garden City branch is staffed by two geologists and two dydraulic engineers. It is engaged in the observations of the water wells throughout the state, the preparation of studies related to irrigation and the investigation of the downward movement of water through the zone of aeration with the use of a neutron probe.

Cooperative Projects

United States Bureau of Mines

For many years the state Survey cooperated with the U.S. Bureau of Mines in collecting statistical data on annual mineral production, reports of which were published in the U.S. Bureau of Mines' Mineral Resources publications later to become the Minerals Yearbook. Annual reports by the Bureau of Mines have been co-authored by personnel of the state Survey since the publication of the first three volume editions of the Minerals Yearbook in 1952.

United States Geological Survey

Cooperative geological projects of the Survey's Mineral Fuels Division with the U.S. Geological Survey date back to at least 1921 when A. E. Fath published his report on the Geology of the Eldorado Oil and Gas Field as Bulletin 7 of the State Survey. Because the appropriations for the state Survey were insufficient in the 1920's special arrangements were made with the U.S. Geological Survey to undertake important and pressing field work in Kansas. Such projects in general were related to oil and gas developments, especially in the central and western parts of the state where the finding of new oil and gas fields seemed most promising. (Rubey and Bass, 1925; Bass, 1926). Attention was also directed to the coal-bearing counties of Crawford, Cherokee, and Labette and to Cowley, Butler, Greenwood counties (Bass, 1936). Beginning about 1938 the cooperative work of the state Survey with the Fuels Board of the federal Survey was put on a permanent and continuing basis with Wallace Lee of the federal Survey being assigned to the Kansas office. The work of Lee was devoted

largely to subsurface studies of Kansas strata and to oil and gas development of Jefferson and Leavenworth counties (1939, 1940, 1941, 1943, 1944, 1948). Publications of a cooperative nature with the U.S. Geological Survey, Minerals Fuel Division, include Bulletins 7, 10, 11, 12, 23, 24, 26, 30, 31, 33, 38 Pt. 10, 51, 53, 74, 109 Pt. 5, and 121. In addition, Oil and Gas Investigations, numbers 8, 9, 11, 12, 13, 19 and 28 are cooperative projects of the two surveys.

Ground-Water Division

In 1937 the state survey made a cooperative agreement with the Ground-Water Division of the U.S. Geological Survey to investigate the ground-water resources of the state. This agreement included cooperation with the Division of Sanitation of the Kansas Board of Health and the Division of Water Resources of the State Board of Agriculture. The first special project was a careful study of the ground-water area north of Wichita known as the Equus beds, a study later supported by the city of Wichita (Moore, 1940, p. 32). S. W. Lohman of the U.S. Geological Survey directed the cooperative ground-water projects. Lohman was succeeded by V. C. Fishel in 1945 who in turn, in 1963, was followed by Robert J. Dingman. The first report published under this new cooperative agreement was A Preliminary Report on the Water Supply of the Meade Artesian Basin (Bulletin 35) by John C. Frye in 1940. Other ground-water reports soon followed in rapid succession so that by the end of 1963, a total of eighty out of eighty-one ground-water reports, mainly county studies, had been published by the Survey. By March 1, 1964, a total of seventy-five of the 105 counties had been investigated, fully or in part, for ground-water resources.

State Agencies

Water Resources

On July 26, 1954, the State Finance Council met in a special session to discuss the severe drought conditions in Kansas and to consider the feasibility of allocating money from the State Emergency Fund for a state-wide water study. The Council created a committee of three for the purpose of providing the legislature with factual data which would enable the members of that body to establish a comprehensive water study and conservation program. Responsibility for directing the study was assigned to the Kansas Water Resources Fact Finding and Research Committee. The committee was composed of Dr. Frank C. Foley, Director of the State Geological Survey, as chairman; Dr. Dwight F. Metzler, Chief Engineer, State Board of Health; and Mr. Robert V. Smrha, Chief Engineer, Division of Water Resources, State Board of Agriculture. As a result of its studies, the committee issued in 1955 a 216-page report entitled Water in Kansas with an appendix of 178 pages.

Governor's Economic Development Committee

The State Geological Survey's cooperation with the Governor's Economic Development Committee was authorized by a 1961 resolution of the legislature. The Economic conditions in the state based on the 1960 census and project such economic conditions into the future, but not beyond 1975. Ten special studies were undertaken by the committee, one of which was entitled Mineral and Water Resources. The sector report on mineral and water resources, a 148-page report, published in 1962, was prepared largely by the staff of the State Geological Survey under the direct super-

vision of Associate Director William W. Hambleton. Dr. Hambleton, who wrote the report, also served as a research consultant on the staff of the Economic Development Committee.

Kansas State Board of Agriculture

The Geological Survey has cooperated with the State Board of Agriculture for many years. From 1898 to 1950, the state geologist has served as an appointed officer of the Board of Agriculture. Since that time, a staff member of the Survey and, more recently, the senior geologist serves the Board's Water Resources division as consultant in matters pertaining to the location of lakes, dam sites and other projects involving geological advice.

Kansas State Corporation Commission, Conservation Division

Each year the Oil and Gas Division of the Geological Survey prepares and published a bulletin on the Oil and Gas Developments in Kansas. These bulletins, largely statistical in nature, are possible through the fullest cooperation with members of the Conservation Division of the State Corporation Commission.

Detailed Large-Scale Maps

Geological Map: There was no detailed geologic map of Kansas until 1937. Prior to that time several small, general geologic maps of the state appeared in the publications of the Survey and elsewhere. None of these maps, however, depicted the detailed geology as seen on the 1937 maps. The map, published under the direction of Drs. Moore and Landes, measured 40 x 51 inches. It was on a 1:500,000 scale (approximately eight miles to the inch) and in colors. This map showed not only the geologic systems represented in the state but also the various series and groups of strata as well as many individual formations. The most recent and revised geologic map of the state, on the same scale and also in colors, was published in June of 1964. This map, which was prepared under the supervision of Dr. J. M. Jewett, Senior Geologist of the Survey, portrayed the geology of Kansas in even greater detail. For the first time the distribution of the Pleistocene or glacial formations was shown.

Mineral Resources Map: Two large (31.5 by 45 inches) mineral resources maps of Kansas have been published by the Survey. The first, in six colors, was published in 1942, and the second appeared in 1951. They show by colors and symbols the distribution of the state's mineral resources and the location of quarries, pits, and processing plants.

Petroleum Industry in Kansas Map: This map, 27 x 52 inches and in four colors showing the location of the oil and gas fields in the state together with the pipelines, was first published in 1948 by Earl Nixon. A revised edition of the map by E. Goebel appeared in 1953 and again in 1958. Each year since 1958, the map has been revised and published under the caption Oil and Gas Fields of Kansas and included as the first

plate in the bulletin on Oil and Gas Development issued annually by the Oil and Gas division of the Survey. Pipelines are no longer shown on these maps since a separate map for Oil and Gas Pipelines and Industries in Kansas is now issued by the Survey.

Kansas Pits and Quarries Map: A map, 20 x 32 inches, by Kulstad and Nixon showing the location of pits and quarries in Kansas was published by the Survey in 1951. This map, now out-of-date, is no longer available for distribution but may be consulted in Bulletin 90, Part 1, Reports of Studies for 1951.

Oil and Gas Pipelines and Industries in Kansas Map: The most recent of the large maps prepared by the Survey is the Map of Oil and Gas Pipelines and Industries in Kansas by Margaret Oros. This colored map, measuring 40 x 54 inches, was issued in 1964.

Other Large Scale Maps

Other maps and cross-sections of portions of the state and various rock classification charts have been published by the Survey from time to time. Notable among such maps are those by Abernathy who in 1944 published the Strip-Mined Areas in the Southeastern Kansas Coal Field, Mined Areas of the Weir-Pittsburg Coal Bed, also in 1944; and the Map Showing Geologic Structure of Southeastern Kansas Coal Fields and the Kansas Zinc-Lead District by W. G. Pierce and others in 1935. Still other maps and cross-sections have been published in the Oil and Gas Investigations series (see Appendix A).

TOPOGRAPHIC MAPS

Topographic mapping in Kansas by the Topographic Branch of the U.S. Geological Survey dates back to 1884. By 1903 approximately 59,500 square miles or seventy-two percent of the state had been covered by reconnaissance topographic quadrangles. Since the turn of the century the reconnaissance type of topographic maps has given way to more detailed maps on a larger scale and with a smaller contour interval, especially since 1923 (Table 9).

All of Kansas east of the one hundredth meridian and practically half of the remaining western portion lying west of the same meridian is now topographically mapped. The entire state is now covered by twelve topographic sheets, on a scale of 1:250,000 and portions of three Colorado sheets. The contour interval of this series is one hundred feet. In addition, there is also now available a large topographic map of the entire state, 32 x 52 inches, with a contour interval of two hundred feet. A summary of the number of topographic quadrangles mapped in Kansas from 1884 to 1963 is presented in Table 9.

TABLE 9--Topographic Quadrangles, Kansas: 1884-1963

Area	Scale	Contour Interval feet	Approx. Sq. Miles	Number of Quadrangles		
				1884-1903	1900-1960	1923-1963
30'	1:125,000	20, 25, 50	59,500	65		
15'*	1: 62,500	10, 20, 25	10,400		45	
7.5'**	1: 24,000	5, 10, 20	19,100			311

* A number of topographic quadrangles of bordering states extend a short distance ~~into Kansas.~~

into Kansas. Such maps, unless extending into Kansas more than two or three miles, are not considered in the above table.

* Several quadrangles of this area are on a scale of 1:48,000 with twenty-foot contour interval.

** Several quadrangles of this area are on a scale of 1:31,680 with contour intervals of five and ten feet.

FUTURE OF THE SURVEY

In 1864 it was thought that the 82,276 square miles that make up Kansas could be surveyed geologically in one year. In 1964, one hundred years later, even though much of the geology of the state is now known, much remains unknown, particularly the subsurface formations. With technological advances and increased skill, new and better surveying and drilling equipment, the use of intricate machines such as computers, the demand for new products and creation of other products produced through ^ebeneficiation of existing low grade raw materials, and a greater insight in the economic development of the state, the Geological Survey of Kansas is destined to keep busy for another hundred years and more. The Survey, now considered one of the foremost geological surveys in the United States, is expecting continued growth, expansion and increased state activity in the immediate years ahead. This expectation is reflected in the anticipation of a new and much needed Survey building (Hambleton, 1964, and Muilenberg, 1964).

Crowding of present facilities in Lindley Hall, also known as the Mineral Resources Building, has been brought about by the expansion of the regular University departments of geology, geography and others. These departments are increasing in staff and hence need more office space. They are also in need of more class and laboratory rooms. Space for the Survey, therefore, is at a premium, thereby jeopardizing increased service to the state. Tentative plans have been drawn for a new Survey building (Fig.) designed especially for the utilization of all space and for serving the needs of the Survey adequately for years to come. The proposed location of this building is in the general research area of the University west of the main campus.

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