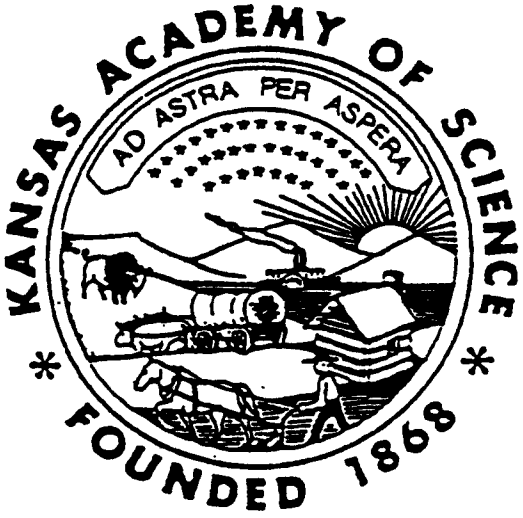
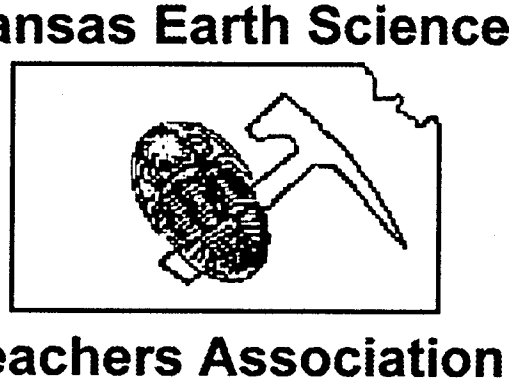
COMBINED KANSAS ACADEMY OF SCIENCE AND KANSAS EARTH SCIENCE TEACHERS ASSOCIATION MULTIDISCIPLINARY GUIDEBOOK 11

FALL FIELD TRIP IN BARBER AND KIOWA COUNTIES SOUTH-CENTRAL KANSAS





October 3, 1998
Kansas Geological Survey
Open-File Report 98-41

COMBINED KANSAS ACADEMY OF SCIENCE AND KANSAS EARTH SCIENCE TEACHERS ASSOCIATION MULTIDISCIPLINARY GUIDEBOOK 11

FALL FIELD TRIP IN BARBER AND KIOWA COUNTIES SOUTH-CENTRAL KANSAS

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KESTA-KAS COMBINED FALL FIELD TRIP

OCTOBER 3, 1998

This year the combined KAS-KESTA fall field trip will begin in the small, unincorporated town of Belvidere in southeastern Kiowa County. Belvidere is more or less equidistant from Pratt, Medicine Lodge, Greensburg and Coldwater. These towns have motels, restaurants, grocery stores and gas stations.

We plan to meet at the Belvidere City Park (behind the Trails End Junk Shop) at 7:45 A.M., Saturday, October 3, 1998. The town of Belvidere provides free camping at the city park for those who like to camp out on Friday evening. There is potable water and pit toilets along with adequate flat ground for tents and campers.

Four stops are planned for the day (figure 1). The first stop will be at the National Gypsum Company gypsum mine, where we will visit both the underground operation as well as the open-pit quarry. This stop offers ample opportunity to collect gypsum and anhydrite samples. The second stop is at a gypsum cave. A small creek has dissolved the gypsum and created a small cave along the creek bed where bats make their home. The climb down into the creek bed and the cave requires a bit of agility. After this stop we plan to have lunch, probably in Belvidere at the city park. After lunch we will travel to the upper Thompson Creek wetland to find Arkansas darters and hopefully wee beaver dam communities. The last stop of the day is planned to study and collect well-preserved fossils in the Champion shell bed in the Kiowa Shale.

STOP 1. GYPSUM MINE

The gypsum mine at Sun City is operated by the National Gypsum Company. The raw material is hauled by rail or truck to the plant in Medicine Lodge for further processing and fabrication of their final products.

Mining of gypsum in Barber County dates back to the later part of the last century. The interesting history of mining and the geology of the deposits was described by Kulstad and others (1956). Attention was drawn to the area after Professor Robert Hay wrote a magazine article for Harper's magazine, which was published in June, 1888, in which he described and illustrated the mansard-like hills of Barber County, and gave a good description of the gypsum rock found there in great quantities. The information came into the hands of English capitalists, who manufactured what is known in England as Keene's cement, a variety of cement known throughout Europe as being superior to anything else of foreign make for use as a high-grade plaster in expensive buildings. As a result a branch factory of the Keene's Cement Company was established at Medicine Lodge and began operation in 1891 under the management of Mr. Thomas best, producing a plaster known as Best's Keene's cement.

Originally gypsum was mined from quarries a few miles southwest of Medicine Lodge. Later operations were moved to a place called Kling in northwestern Barber County and subsequently to the area where the present-day mining takes place (figure 1). Xerox copies of photographs taken of the early quarry operations are included in Appendix A. It is interesting to note that the excellent quality of the gypsum made it worthwhile to exploite the deposits in the


Stop 1
Stop 2
Stop 3
Stop 4
START
Belvidere
Sun City
Haviland
Cullison
Wilmore
Radio Tower
SOUTHWESTERN
TURKEY CREEK
SUN CITY
P O W E L L
OIL AND GAS FIELD
KIOWA CO
PRATT CO
BARBER CO
COMANCHE CO
T W P 10
TOWNSHIP NO 10
Medicine
Mule
Soldier
Creek

Figure 1

rough terrain. As the quarries advanced into the hills the overburden eventually became to thick to be easily removed and operations moved underground around 1930 or 1931. Also in the 1930's the present owner, the National Gypsum Company, took the mining operation over. The mine is known as the Pioneer mine.

The gypsum occurs in the Blaine Formation, which almost entirely consists of gypsum separated by dolomite and red shale. The Blaine Formation is further subdivided into four members (figure 2), of which the upper three members are absent in many places. The Blaine Formation is about fifty feet thick and is widely exposed at the surface in Clark, Comanche, Kiowa, and Barber counties (figure 3). The type locality of the Blaine Formation is Salt Creek Canyon near Southard, Blaine County, Oklahoma (Gould, 1905). In the Sun City area the upper Medicine Lodge Gypsum member is the only member present and ranges in thickness from 10-30 feet. Farther to the west in Comanche County other members of the Blaine Formation are present. In the mine area the Medicine Lodge member generally consists of an upper and lower gypsum bed separated by an anhydrite bed (Appendix B). The anhydrite bed varies quite a bit in thickness and in places is absent. The lower contact of the anhydrite is more or less horizontal whereas the upper contact is wavy. Where the anhydrite is present, the base of it occurs about ten feet above the base of the gypsum.

Where the anhydrite is not present, there is evidence that it was present at one time and has been dissolved. In its place are now solution channels forming zones filled with breccia in which the gypsum is crumbly, porous and sugary and shows traces of red clay At the base of the gypsum bed is a 6-12 inch hard, impure dolomite.

The Medicine Lodge member of the Blaine Formation extends westward into Comanche County and southward into Oklahoma. The regional dip of the gypsum bed is about 11 feet per mile to the southwest. Calcium sulfate occurs naturally as gypsum ($CaSO_4 2H_2O$) and as anhydrite ($CaSO_4$). Other forms of calcium sulfate are known, but they are not found in nature. The specific gravity of gypsum is 2.32 and its hardness is 2, making it easy to scratch with a knife blade. The pure mineral is colorless, white, or gray. Small amounts of impurities can give the mineral a yellow, red, or brown color. Gypsum generally occurs as massive or rock gypsum in which individual crystal shapes are impossible to recognize, or as intimately intergrown masses of fine granular to coarse crystalline material. Individual crystals commonly are tabular and simple in habit, and frequently have warped or curved surfaces. Selenite, occurring as coarsely crystallized material, and satin spar, having a fibrous structure are common varieties of gypsum. All three minerals are widely distributed in Permian sedimentary rocks.

Anhydrite, on the other hand has a slightly higher specific gravity of 2.93 and also has a greater hardness of 3 to 3.5. Anhydrite generally is massive and is white in color, but small impurities can make it look blueish, grayish, or reddish.

The common association of calcium sulfate and halite is evidence that both minerals have been deposited by direct evaporation of sea water in shallow, restricted basins. Other interpretations have been proposed, such as deposition from marine, deep water, stratified basins (Lowenstein and others, 1989), or deposition in ancient ephemeral saline lakes and associated mudflats (Benison, 1997).

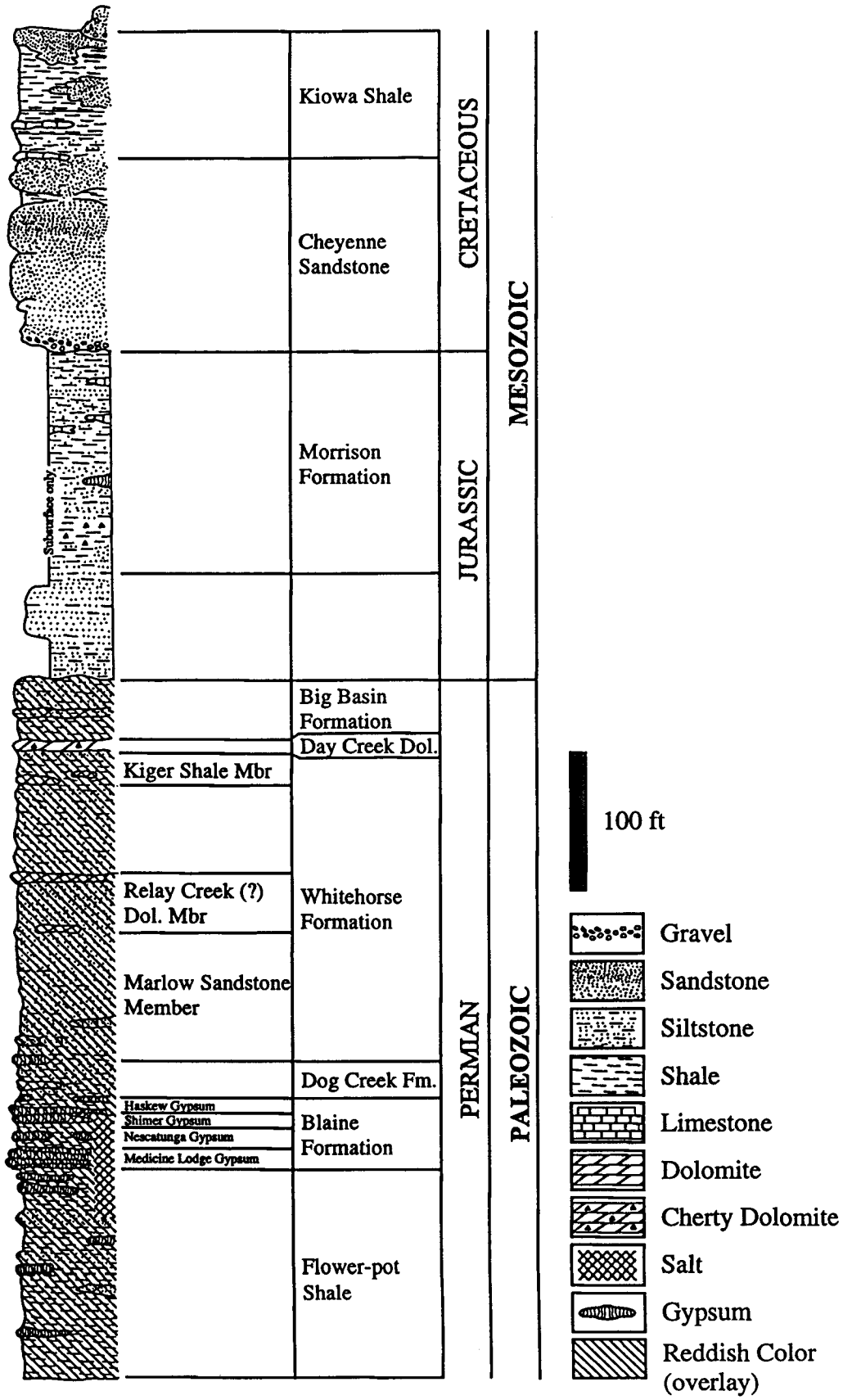
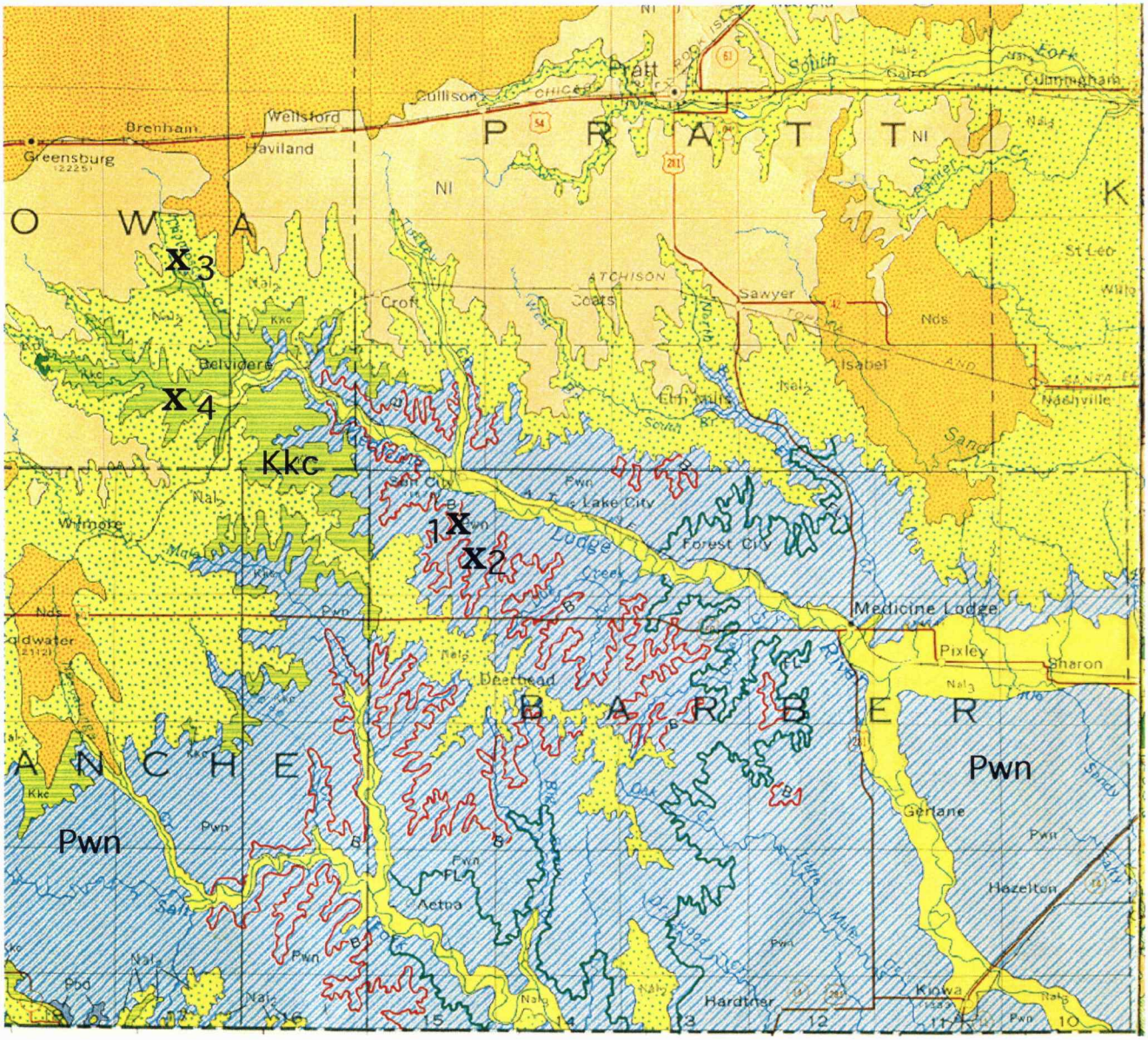

Kiowa Shale
Cheyenne Sandstone
Morrison Formation
Subsurface only
Big Basin Formation
Day Creek Dol.
Kiger Shale Mbr
Relay Creek (?) Dol. Mbr
Marlow Sandstone Member
Whitehorse Formation
Dog Creek Fm.
Haskew Gypsum
Shimer Gypsum
Nescatunga Gypsum
Medicine Lodge Gypsum
Blaine Formation
Flower-pot Shale
CRETACEOUS
JURASSIC
PERMIAN
MESOZOIC
PALEOZOIC
100 ft
Gravel
Sandstone
Siltstone
Shale
Limestone
Dolomite
Cherty Dolomite
Salt
Gypsum
Reddish Color (overlay)

Figure 2



Blaine Gypsum (Base)

Flowerpot Shale (Base)

X 1 Field trip stops

Pwn Permian-Whitehorse Formation, Flower-pot Shale

Kkc Cretaceous-Kiowa Shale, Cheyenne Sandstone

Units colored in shades of yellow, brown, and orange are Cenozoic in age

Figure 3

References:
Kulstad, R.O., Fairchild, P., McGregor, D, 1956, Gypsum in Kansas: Kansas Geological Survey Bulletin 113, 110 p.
Gould, C. N., 1905, Geology and water resources of Oklahoma: U. S. Geological Survey Water-Supply Paper 148, p. 1-178.
Benison, K. C., 1997, Acid water deposition and diagenesis in Permian red bed-hosted evaporites, midcontinent, U.S.A.: Ph. D. thesis, Department of Geology, University of Kansas, 420 p., Kansas Geological Survey Open-File Report 97-92.
Lowenstein, T. K., Spencer, R. J., and Pengxi, Z., 1989, Origin of ancient potash evaporites: Clues from the modern nonmarine Quidam basin of western China: Science, v. 245, p. 1090-1092.

STOP 2. TRIPLE ARCH CAVE

Gypsum and anhydrite at and just below the surface are easily subjected to dissolution by meteoric water. This sulfate mineral dissolution, along with probable dissolution of halite beds at shallow depths, has resulted in a karst topography in southcentral Kansas and northern Oklahoma. Sinkholes (mostly dry), collapsed blocks, caverns, and natural bridges exist in the field area. On a smaller scale, hollow mounds and solution enlarged fractures are abundant in the Blaine Formation gypsum and anhydrite. One can hear a hollow sound when stomping on some of this gypsum.

Triple Arch Cave (figures 1 and 2) is typical of many caves in the Red Hills. As time goes by each cave system will ultimately segment into a number of smaller caves separated by collapse sinks before the roof entirely disappears by means of erosion, solution, or further collapse. Triple Arch Cave is a good example where a cave system consists essentially of three parts separated by two collapses.

The following information has largely been excerpted from a publication on caves in Kansas by Young and Beard (1993). Temperature in many of the caves varies little, staying a fairly constant 50°-60° all year. The humidity stays relatively high, providing a suitable habitat for such trogloxenic fauna as the tiger salamander and a few species of toads normally associated with rivers, ponds, and marshes. Other fauna that frequent the caves are mice, rats, porcupines, coyotes, raccoons, rattlesnakes, tarantulas, centipedes, barn owls, and cliff swallows.

But the best-known cave dwellers, and the ecologically most important, are bats. These much-aligned distant cousins to shrews have incorrectly been given a bad name. Bats are not blind, don't get caught in people's hair or attack people. They are normally docile, timid creatures that are the only flying mammals, and have a perfectly good eyesight. As expert flyers they can change direction and speed better than many bird species. Bats are famous for their sonar or, more correctly, their echo location. By emitting ultrasonic clicks that human ears cannot hear, and catching the returning echo they are able to determine the size, shape, direction of movement, and distance of objects ahead of them. Ecologically bats are very important. A single 2-inch-long bat will consume 2,000-3,000 flying insects each night. Many types of bats occur worldwide, including those that are known as fruit and nectar bats and play an important role in pollinating flowers and dispersing seeds. Bats that make their home in south-central Kansas are described in the next section.

Reference:
Young, J., and Beard, J, 1993, Caves in Kansas: Kansas Geological Survey Educational Series 9, 47 p.

BATS OF THE KANSAS GYP HILLS

Stan Roth
Instructor in biology, Free State High School, Lawrence, KS 66049

Eight species of bats are known to occur with some regularity in the Gyp Hills of Kansas. Two of these, the red bat (*Lasiurus borealis*) and the hoary bat (*L. cinerus*) are migrant and tree-dwelling species that may be seen from time to time in wooded canyons and ridges. The former is fairly abundant and probably breeds in the area every summer. The latter is quite rare and probably is present only occasionally during the warmer part of the year.

The remaining species are cave dwellers. One is a migrant, the others are resident throughout the year.

1. CAVE MYOTIS (*Myotis velifer*). This is the most common species in Kansas gypsum caves. Kunz (1973) noted that caves may be designated as hibernation, transition, or maternity caves depending on their use during the year. The bats occur in varying numbers, ages, and sex ratios as bat activity waxes and wanes. Some maternity colonies are in remote barns. In the Kansas Gyp Hills, the cave myotis is at the most northeastern limit of its range in the United States.

2. BIG BROWN BAT (*Eptesicus fuscus*). This species is usually solitary and may be found in caves throughout the year. It is much less numerous than the cave myotis. Females aggregate to form maternity colonies, usually in buildings and in rock crevices of open bluffs, while males remain at the caves. The big brown bat likes to sleep in narrow rock slits where both its belly and back are touching. It may be found in places where a cave is not fully dark.

3. BIG-EARED BAT (*Plecotus townsendi*). Like the big brown bat, this species is a cavern dweller throughout the year. It is usually solitary, but may form small hibernating clusters and maternity aggregations. This small bat's huge ears and fluffy fur make it appear larger. When asleep, the ears are curled backward and downward on the sides of the head (rams-horn like) and it may wrap its wings around itself. This is a rather slow-flying bat and seems to prefer moths as food. There is some concern that his species is declining in numbers.

4. PALLID BAT (*Antrozous pallidus*). This is the largest and rarest bat in Kansas. This species secretes itself in open crevices in cliffs during the day but may resort to caves for temporary roosting places at night, between intervals of feeding. It usually alights to feed on a variety of terrestrial arthropods. This handsome bat has not been seen at its usual roost/hibernation site in northwestern Barber County since December 1991. It has been seen off and on at this site over the past forty years.

5. EASTERN PIPISTRELLE (*Pipistrellus subflavus*). This is the

smallest bat to occur year-round in Kansas. It is a solitary species that may be found in low, cool, and damp regions of a cavern. It is known to move out and live in trees during the summer. This thumb-sized bat may gather condensed moisture on its fur during hibernation. It is regularly seen in gypsum caves, but never in large numbers.

6. MEXICAN FREE-TAILED BAT (*Tadarida brasiliensis*). This species is a social, highly gregarious, nonhibernating bat that has no known roost or maternity sites in Kansas at the present time. However, there are several large summer maternity sites near the Kansas border in Oklahoma. Evening flights of this bat are familiar throughout the Kansas Gyp Hills, but most return to their day roosts in Oklahoma. Migration to the south occurs in October and return is in April. This "guano bat" is the species of the popular bat flights at Carlsbad Caverns and in Austin, Texas.

Reference:

Kunz, T.H. 1973. Population studies of the cave bat (*Myotis velifer*): reproduction, growth, and development. University of Kansas Museum of Natural History Occasion Papers, 15:1-43.

STOP 3. LONE TREE CAMP

Thompson Creek is the largest of several streams in southeastern Kiowa County (figures 1 and 2). These streams are headed by springs that provide a perennial flow to the south into the Medicine River. The site of our visit is fed by several proximal springs that support a specialized local biota. Various common hydrophytes can be found and numerous invertebrates are among them. The Arkansas River darter, an endangered fish species, is common here as are the red-bellied dace and plains killifish. Watch for evidence of beaver throughout the area. The fauna is special whatever the season.

STOP 4. CHAMPION SHELL BED

The Champion Shell (figure 1) bed is a persistent, thin coquinoidal limestone bed near the base of the Kiowa Formation. The term coquinoidal refers to the fact that the unit is almost entirely made up of coarse, unsorted, and often unbroken shelly materials that have accumulated in place without subsequent transportation or agitation, and generally having a fine-grained matrix. The Champion Shell Bed was first described by Cragin (1895), who gave it equivalent rank in stratigraphic value to the Cheyenne Sandstone and the Kiowa Shale. The bed is persistent in the Belvidere area, forming a well-developed bench above the Cheyenne Sandstone, but according to Latta (1946) was not recognized in test holes drilled in other parts of Kiowa County. Other shell beds occur in the Kiowa Formation, but the fauna of the Champion Shell Bed appears to be unique enough to deserve special attention. Abundant mollusks, commonly known collectively as snails (gastropods) and clams (pelecypods), in general appearance not greatly different from shells on present-day beaches occur in these rocks. High-spiralled, conical snails and a clam called Grypheae are among the most common shells in the Kiowa Formation. There is also a species of oyster that is very much like present-day oysters. Tubes, believed to be worm borings, are plentiful, and there are

some specimens of cephalopods which, like snails and clams, are mollusks.

The Kiowa Formation (figure 3) (formerly Kiowa Shale) consists chiefly of thinly-laminated dark-gray to black shale in the lower part grading upward into gray, tan, mottled tan, red, and brown clay and clayshale. The shale in the lower part generally is black and has been called a paper-shale because it is so thinly laminated. The formation reaches its greatest thickness of about 150 feet in the type area in Kiowa County. Sandstone lenses commonly occur within the shale sequence away from the type area, and are most abundant in the upper parts of the formation. Lenses and concretions of calcareous cone-in-cone are common in the shale. Gypsum, generally in the form of selenite, is also common throughout the formation, and occurs both in the beds of shell limestone and at many different places in the shale. It is also not uncommon to find a thin layer of fibrous aragonite having a cone-in-cone structure capping the shell beds.

More than fifty species and varieties of invertebrate fossils have been identified in the Kiowa Formation (Latta, 1946). In the black shale immediately above the Champion Shell Bed" fragments of fossil insects, to small to be positively identified, have been found. Numerous vertebrate fossils have also been collected from the Kiowa Formation in this area. Both the invertebrate and vertebrate fossils found in the Kiowa Formation are listed in a publication by Twenhofel (1924).

References:

Cragin, F.W., 1895, Contributions to the paleontology of the plains: Bull. Washburn College Lab. Nat. History, v. 2, p. 65-68.

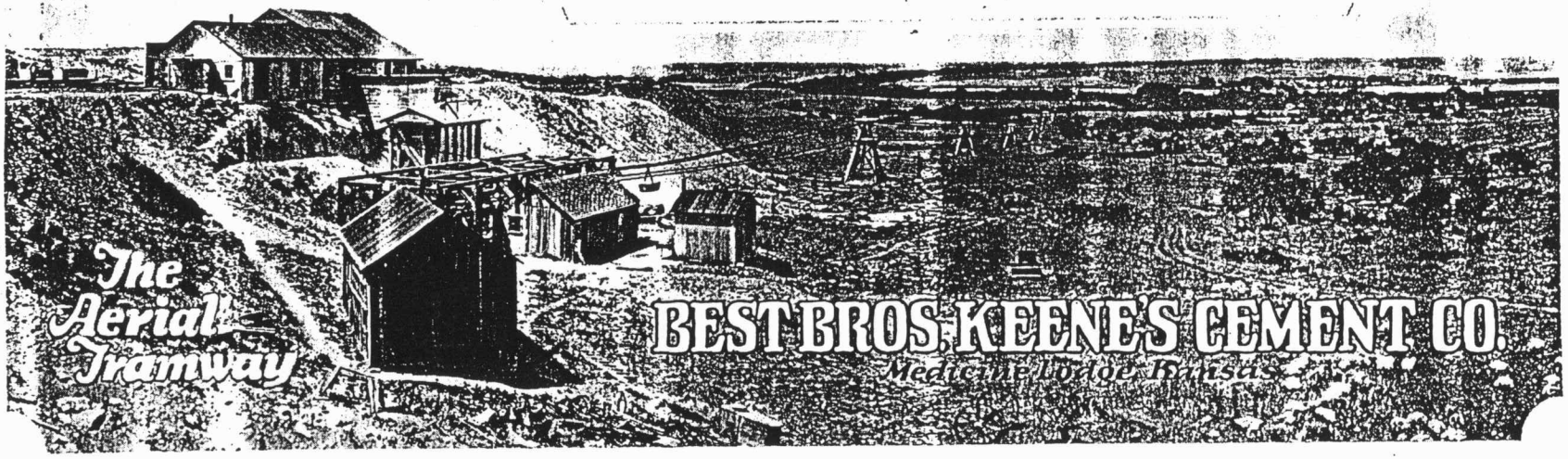
Latta, B.F., 1946, Cretaceous stratigraphy of the Belvidere area, Kiowa County, Kansas: Kansas geological Survey Bulletin 64, pt. 6, p. 217-260.

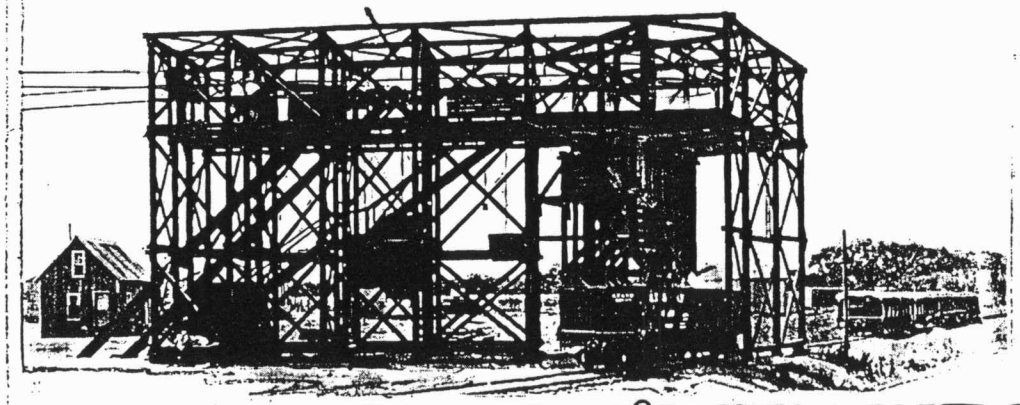
Twenhofel, W.H., 1924, Geology and invertebrate paleontology of the Comanchean and "Dakota" formations of Kansas: Kansas Geological Survey Bulletin 9, 135 p.

APPENDIX A

ON account of the rapid elevation and many intersecting canyons of the Gypsum Hills, no railroad can approach our quarries. We therefore built an aerial tramway to convey the crushed rock to the cars on our railroad siding. This tramway spans the entire valley of the Medicine River, the tractor cable being an endless steel rope 13,300 feet long. Along it every fifty seconds travel buckets holding a little over half a ton each.

Number Eight of the Series



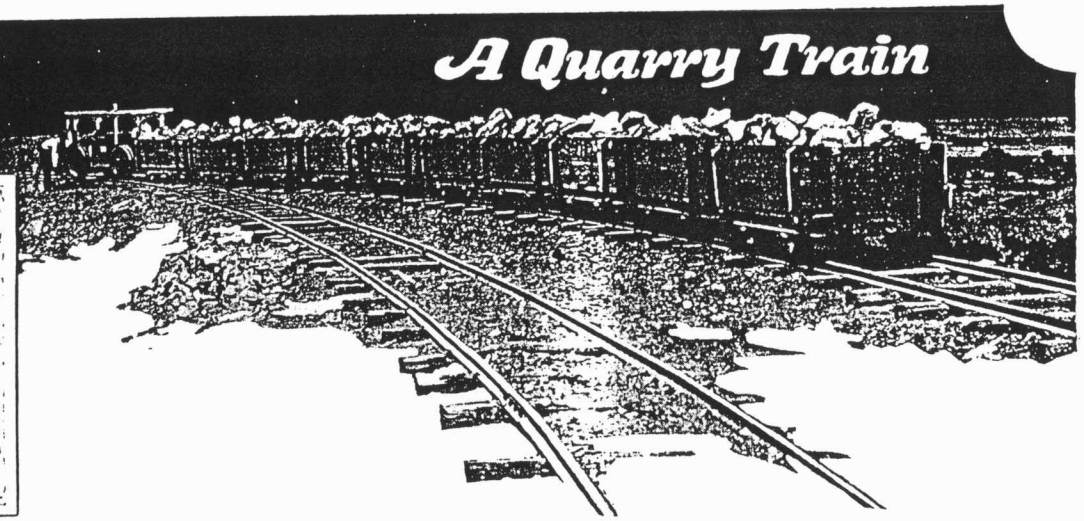


WHEN the half ton buckets holding crushed gypsum from the quarries reach the discharge terminal of our tramway, which is fifty-five feet in height, they are automatically dumped and their contents loaded into cars holding sixty tons each, for transportation to our mills. As you will see from the picture, these cars are covered with canvas so that the rock will be kept absolutely clean in transit.

Number Nine of the Series

BEST BROS. KEENE'S CEMENT CO.
Medicine Lodge, Kansas

A Quarry Train



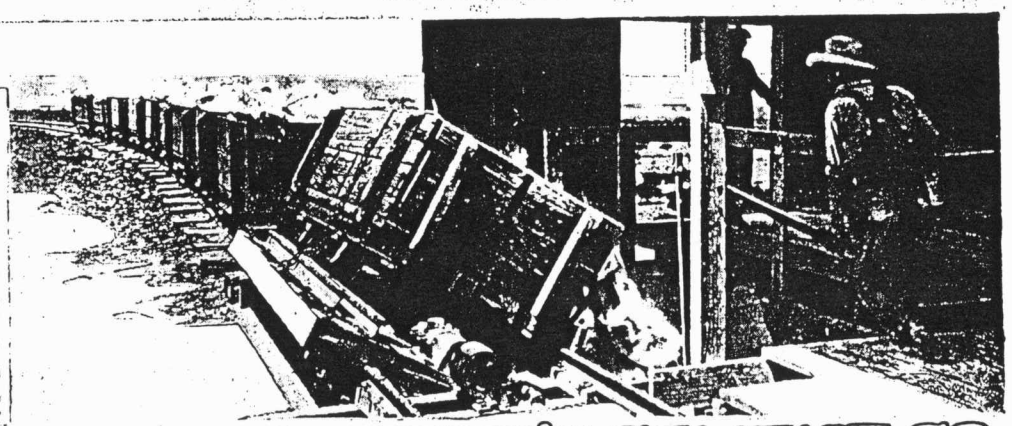
OUR gypsum deposits occur on the tops of hills, making our quarries widely scattered. Trains of dump cars hauled by narrow gauge locomotives gather up the rock from the quarries, and convey it over miles of track perched high above the valley to the big crushers at the head of the cableway.

Number Six of the Series

BEST BROS. KEENE'S CEMENT CO.

Medicine Lodge, Kansas

Dumping Rock Cars



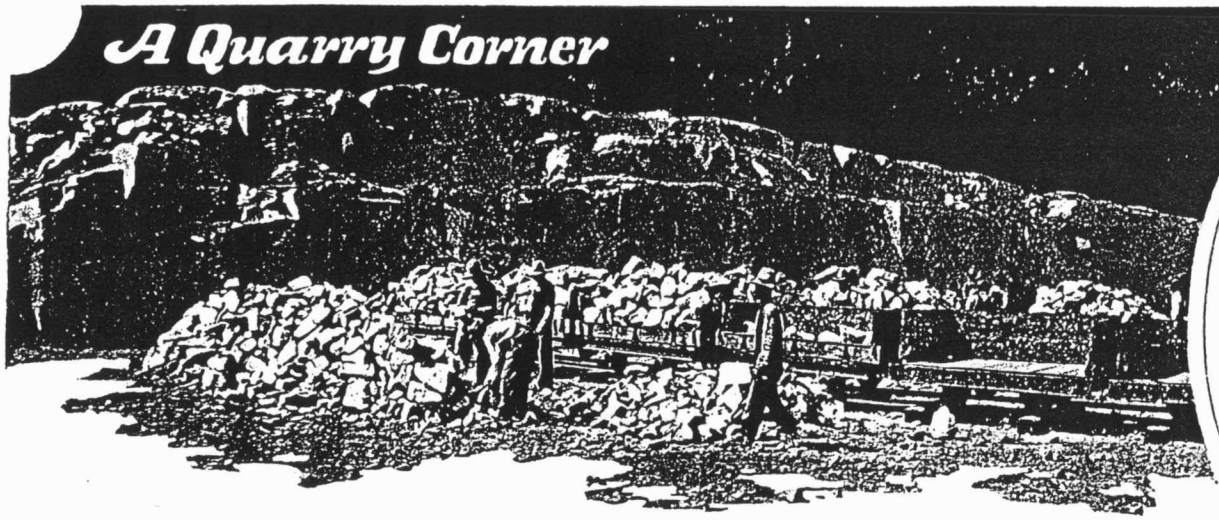
WHEN the rock cars reach the crusher house, located on a bluff at the extreme edge of the Medicine River Valley, they are dumped into a hopper feeding a large crusher. From this the rock passes through a secondary crusher, and thence to the storage bins. From blocks weighing 100 lbs. it has now been reduced to the size of small gravel.

Number Seven of the Series

BEST BROS. KEENE'S CEMENT CO.

Medicine Lodge, Kansas

A Quarry Corner



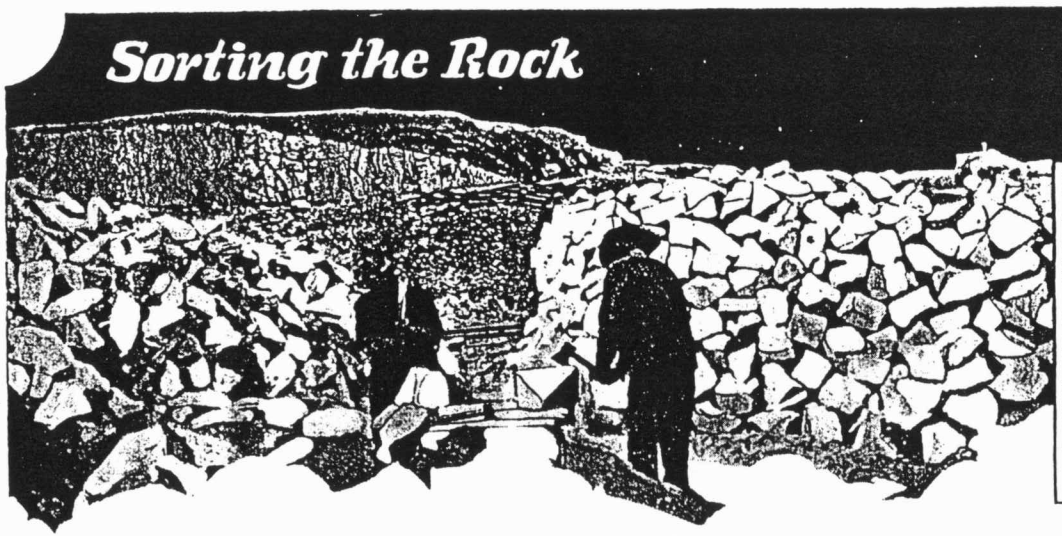
WE are proud of this picture. If there is another gypsum deposit in the United States like it, we have yet to see it. Most gypsum occurs in veins only a few feet thick, interspersed with dirt, thus giving the finished product a pinkish color. You will see from the pile of rock on the floor of the quarry that our gypsum is white, for it comes from a solid block practically free from dirt. The face shown is 21 feet high; the rock itself is 99.6% pure.

Number Four of the Series

BEST BROS. KEENE'S CEMENT CO.

Medicine Lodge, Kansas

Sorting the Rock

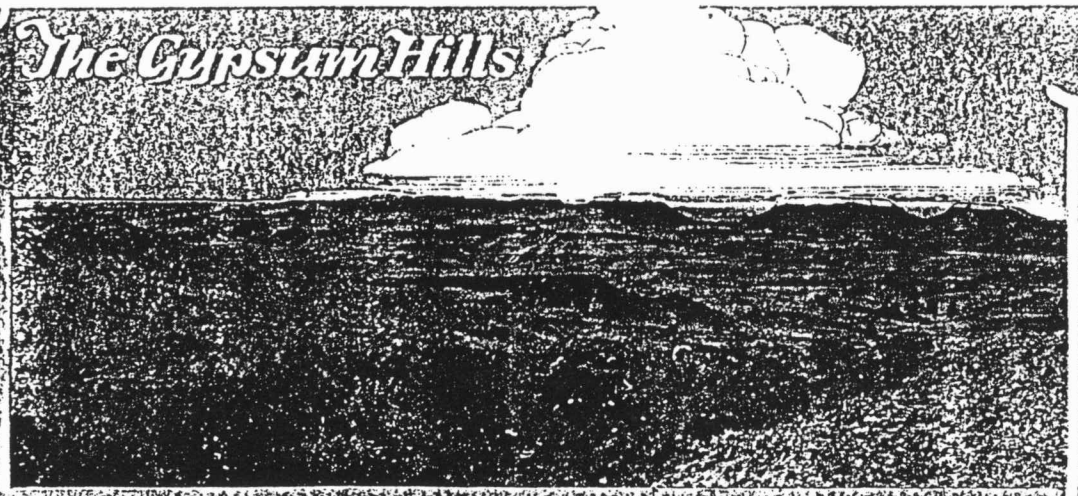


ALTHOUGH practically all our gypsum is so clean that it goes direct from the quarry to the crushers without any treatment, that from which we make our "Superfine" grade is carefully cleaned by hand, so that there can be no possibility of any dirt particles remaining. The "Superfine" grade is used for facing artificial marble, and only the finest, whitest rock is selected for this purpose.

Number Five of the Series

BEST BROS. KEENE'S CEMENT CO.

Medicine Lodge, Kansas

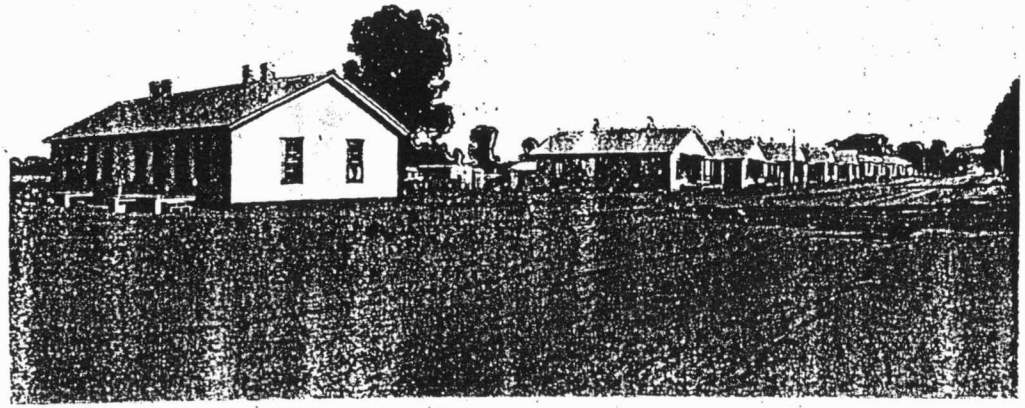


NOT all of Kansas is prairie country. Just west of Medicine Lodge rise the Gypsum Hills, flat topped buttes of red sandstone capped with gypsum—a miniature Bad Lands. Because Nature has taken this way of preserving one of her best treasures, it is practically impossible to build a railroad track to these hills. For this reason gypsum for Best Bros. Keene's Cement has to be transported to the railroad by aerial tramway, which will be shown later in the series.

Number Two of the Series

BEST BROS. KEENE'S CEMENT CO.

Medicine Lodge, Kansas



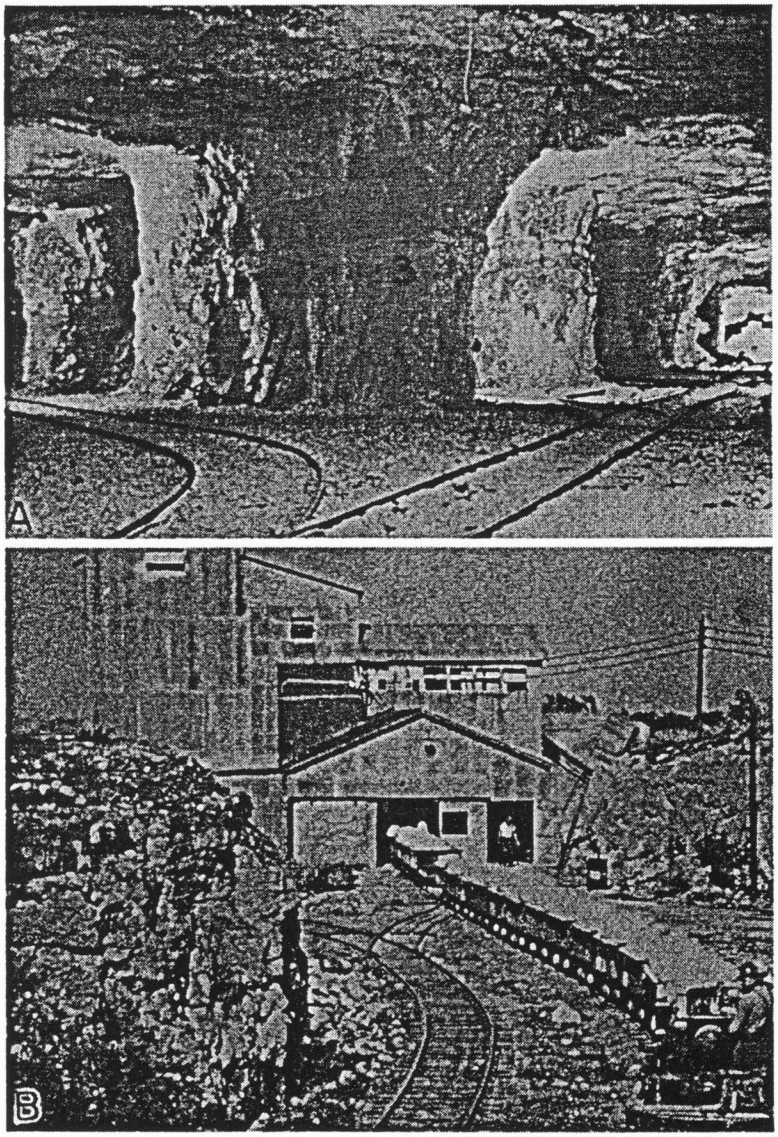
JUST at the foot of the Gypsum Hills are the homes of our employees. Because our quarries are located in such an inaccessible spot, there are none of the usual housing accommodations. We have built our workmen homes, in which they live at a merely nominal rent. Some of our men have been with us ever since our quarries were opened and they have made for themselves a real little community of homes—not a mere stopping place for transients.

Number Three of the Series

BEST BROS. KEENE'S CEMENT CO.

Medicine Lodge, Kansas

APPENDIX B



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