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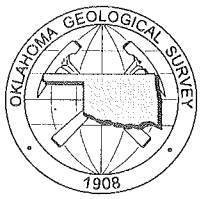

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Copper, Lead, and Zinc in the Ouachita Mountains in Oklahoma and Adjacent Parts of Arkansas

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Oklahoma Geological Survey
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The University of Oklahoma
Norman, Oklahoma

2003

Front Cover

Buffalo Mine on Mine Creek, in NE¼NE¼SW¼NW¼ sec. 14, T. 2 S., R. 26 E., McCurtain County, Oklahoma. View looking north at Stanley quartzite and phyllite, ~250 ft north of Buffalo Creek. Beds strike N. 40–60° E., dip 45° NW. April 11, 1973.

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Copper, Lead, and Zinc in the Ouachita Mountains in Oklahoma and Adjacent Parts of Arkansas

Robert O. Fay
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Norman, Oklahoma

ABSTRACT.—Copper, lead, and zinc minerals have been mined in the Ouachita Mountains of Oklahoma and adjacent parts of Arkansas since the early 1800s. The common ore minerals are chalcopyrite, galena, and sphalerite, and the common oxidized minerals are malachite, azurite, hemimorphite, and limonite. Calcite, siderite, ankerite, barite, celestite, hematite, and quartz are common gangue minerals. The minerals occur in brecciated quartz veins along major faults that crosscut the host rocks, and along shear zones. The host rocks are mainly the Lower Ordovician Collier Formation, consisting of dark-gray phyllites, quartzites, and marbles, and the Upper Mississippian Stanley Group, consisting of dark-gray shales and phyllites, and tan to gray quartzites and sandstones. The Stanley rocks contain 10–30 ppm copper, 5–20 ppm lead, and 50–100 ppm zinc—concentrations typical of average shale and some sandstones. Geothermometric studies on fluid inclusions in quartz and sphalerite indicate a temperature range of 115–165°C for the hydrothermal solutions. The probable source for the copper, lead, and zinc ions is some deep-seated igneous body that was active in Pennsylvanian time.

The mines and prospects are in and around the Choctaw anticlinorium in the southern Ouachita Mountains, where the rocks are tightly folded and overturned, and the faults and axial planes of folds dip steeply northward. The quartz veins occur east of a NE–SW line that extends from sec. 16, T. 4 S., R. 20 E., Pushmataha County, Oklahoma, to sec. 28, T. 1 N., R. 26 E., Le Flore County, Oklahoma. The main ore deposits lie in McCurtain County, Oklahoma, and Sevier County, Arkansas; Sevier County had 1,100 registered claims before 1927. I examined about 25 mines and prospects, some of which are in Polk and Sevier Counties, Arkansas, about 4–6 mi east of the Oklahoma border. Many of the prospects are small pits, but some of the mines were large, the largest being the Davis Mine in Sevier County, where the vein is 40 ft wide, 208 ft deep, and half a mile long. The total rock and ore removed from all of the prospects and mines was ~450,000 short tons. Most of the mines were closed about 1920, because of bad economics, excessive water, or depleted ore. Some of the mines may still have rich ore at depth.

Silver occurs in argentiferous galena, in concentrations generally <2 oz/ton. Gold is absent. Titanium, manganese, strontium, and iron concentrations in ore samples are generally >0.2%. Chromium, cobalt, molybdenum, nickel, tin, and vanadium concentrations generally are <20 ppm. Ankerite, siderite, anglesite, cerussite, covellite, and tetrahedite (with some antimony and mercury) have been reported from the Arkansas mines. In Arkansas, gallium, selenium, arsenic, gold, uranium, rubidium, strontium, zirconium, and yttrium have been reported. In recent years, some major mining companies have expressed interest in these old mines and prospects.

INTRODUCTION

In recent years, many mining companies and individuals have expressed interest in copper, lead, and zinc minerals in the Ouachita Mountains. Their main concerns are to obtain geologic maps on topographic bases showing locations of mines and prospects, to learn about previous investigations, and to have modern analyses of the ore deposits. The present work is a progress report that should be augmented with later detailed investigations. This report is primarily about the Oklahoma portion of the Ouachita Mountains, but it entails adjacent parts of Arkansas (Fig. 1–6).

The early history of many of the mines is lost, and many prospects may have been covered and lost. No detailed maps have been published showing underground workings, as individuals who opened the mines and prospects did not publish their findings. Much of the present

information was obtained from local residents, or from history books and newspapers. Honess (1923) is the best source for McCurtain County mines. Miser and Purdue (1929) published on Sevier and Polk Counties, Arkansas. Miser (1943, 1959), Engel (1946, 1952), Scull (1959), and Bass and Ferrara (1969) summarized much of the general information on mineralization of the Ouachita Mountains. Walthall (1967) published on the southern Ouachitas of Arkansas. Pittenger (1974) and Pittenger and Konig (1977) updated information on the antimony district of Sevier County, including geochemistry of the Bellah and Davis Mines.

The present work is subdivided into studies of three mining districts, in or around the core area of the Ouachita Mountains of Oklahoma. The mines are in McCurtain County, Oklahoma, and Sevier and Polk Counties, Arkansas. The main period of discovery was from 1820 to 1920.

I studied most of the areas in the summer of 1972, and I photographed the mines and prospects in June 1973. At the time of writing this report, references to places and people were valid, but they may have changed since then. David Foster (former analytical chemist with the Oklahoma Geological Survey) analyzed the samples in 1975.

HISTORY OF MINING

In the Ouachita Mountains, the known prospects and mines were discovered between 1820 and 1920, the earliest being the Bellah Mine in the investigated area. Many of the prospects were discovered by accident. For instance, the Bellah Mine was discovered by hogs uprooting galena, the Davis Mine was discovered by a lost boy, and the Johnson prospect was discovered by two deer hunters. Many of the smaller prospects were discovered by John Harpending of Smithville, Oklahoma. He was a graduate mining engineer from the Colorado School of Mines and managed the Reebo Lumber Co. and Dierk's properties. He prospected over much of the Ouachitas in the early 1900s and died in the 1930s at Smithville. Mead Johnson was the first graduate mining engineer from the Oklahoma School of Mines at Wilburton in 1912. He was president of the school in 1919. He prospected in the Ouachitas from 1912 to 1919, opening the Johnson prospect.

In Sevier County, Arkansas, more than 1,100 prospects were filed before 1927 (Mabry, 1966, p. 21). Clark and Parham (1977) give a bibliography of Arkansas county histories. Many prospects have probably been filled in and not reported. Probert (1977, p. 363–384) gives a bibliography to lost mines in Oklahoma. Most of the mines were closed shortly after World War I, because of poor economics, depletion of the ore, or insurmountable water problem. Some mining companies and individuals continue to look at these areas.

GEOLOGY

The Ouachita Mountains of southeastern Oklahoma are a series of hills that strike E–W, with about 2,000 ft of relief. Structurally, the faults and folds dip southward in the northern part and dip northward in the southern part. The mining districts are around the core area in the southern Ouachita Mountains.

Stratigraphically, the oldest rocks are Early Ordovician in age, in the center of the Choctaw anticlinorium of the core area. These rocks are overlain by Middle Ordovician and younger rocks ranging to Lower Pennsylvanian. The named units and their respective thicknesses in or near the core area are as follows:

	Thickness (m)
Pennsylvanian (Morrowan):	
Lynn Mountain Formation	2,200
Johns Valley Shale	100–615
Jackfork Group	2,000
Mississippian	
Stanley Group { Moyers Formation / Tenmile Creek Formation	3,660
Mississippian to Lower Silurian	
Arkansas Novaculite	200–275
Lower Silurian	
Missouri Mountain Shale	30–75
Blaylock Sandstone	9–450
Upper Ordovician	
Polk Creek Shale	22–62
Middle Ordovician	
Bigfork Chert	195–255
Middle Ordovician	
Womble Shale	300–1,200
Blakely Sandstone	3–180
Lower Ordovician	
Mazarn Shale	300–1,050
Crystal Mountain Sandstone	150–270
Collier Formation	300
Lower Ordovician through Cambrian	
pre-Collier to basement	6,000? (basement not seen)

Most of the foregoing stratigraphic sequence is from Gordon and Stone (1977, p. 87) and from Davies and Williamson (1977, p. 116) after Charles Stone and Boyd Haley. Some is from Honess (1923).

The Ouachita rocks are mainly dark-gray to black shales and sandstones, of deep-water turbidite facies, except for some of the Ordovician units, which may have been formed in shallow water. In the core area, the rocks are tightly folded and metamorphosed to phyllites, quartzites, and marbles. The only published subsurface information about rocks older than the Collier is that of Goldstein (1975), who described the samples from the Viersen and Cochran 25-1 Weyerhaeuser well in sec. 25, T. 5 S., R. 23 E., to a total depth of 10,019 ft. The rocks are essentially like those at the surface, with some copper mineralization. The basement was not reached. (See discussion under Carson District for further information.)

The copper, lead, and zinc minerals occur mainly in the Collier Formation and rocks of the Stanley Group.

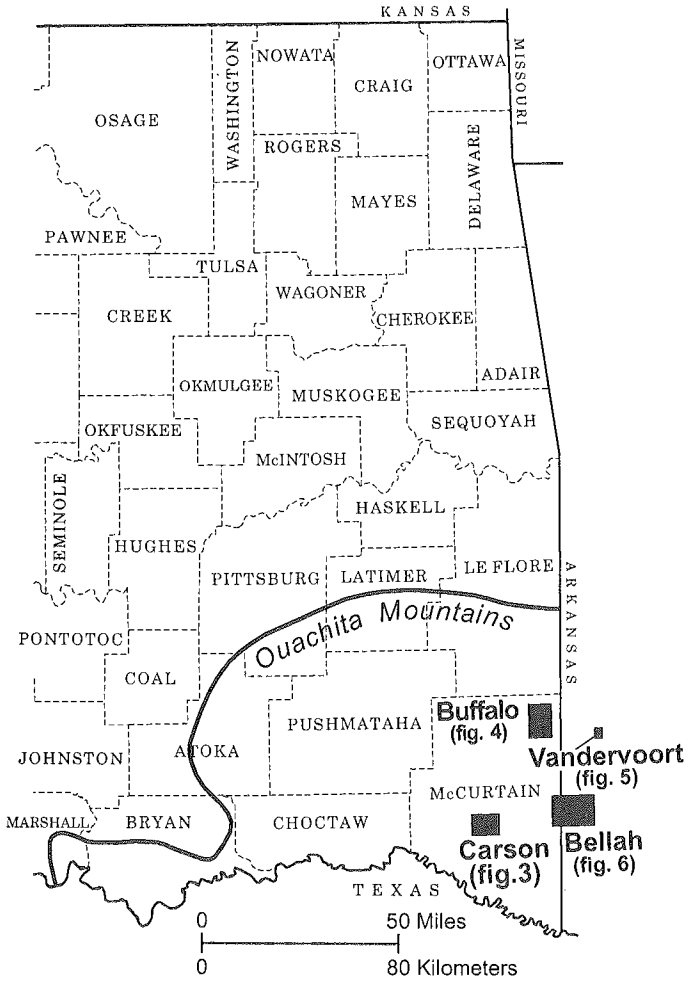


Figure 1. Index map of Oklahoma and Arkansas showing location of mining districts in Ouachita Mountains.

The Collier consists of ~1,000 ft of dark-gray phyllites, quartzites, and calcitic and dolomitic marbles, tightly folded and faulted, with many quartz and feldspar veins. The Stanley consists of 11,000 ft of olive-gray shales and dark-gray phyllites, with many thin tan quartzites and sandstones. In the lower 1,000 ft are several volcanic-tuff beds, one of which is termed the Hatton Tuff.

The Stanley Group is subdivided into the Moyers Formation above (3,000 ft thick), and the Tenmile Creek Formation below (8,000 ft thick). Several thin chert beds are present in the Stanley. The Schoolhouse Chert is at the base of the Moyers, and the Battiest Chert or Smithville Chert occurs in the middle of the Tenmile Creek, with the Albion Chert near the base of the Tenmile Creek. The Chickasaw Creek Chert, speckled black and white, is at the base of the Jackfork Group, above the top of the Moyers Formation.

It is difficult to place the Stanley ores stratigraphically because of complex faulting and extensive cover, although the Buffalo and Bellah District ores lie generally below and above the Battiest Chert, respectively. Generally, the ores occur in brecciated quartz veins along faults.

Miser (1943) considered the ores to be of hydrothermal origin and Pennsylvanian in age. Pittenger and Konig (1977, p. 24–25) studied fluid inclusions in quartz and sphalerite, concluding that the hydrothermal solutions ranged in temperature from 115° to 165°C and that the source of the copper, lead, and zinc was from an igneous body of Pennsylvanian age. They showed that the Stanley contains 10–30 ppm copper, 5–20 ppm lead, and 50–100 ppm zinc, which is the same as an average shale and some sandstones, concluding that the Stanley was not a source for the metallic ions.

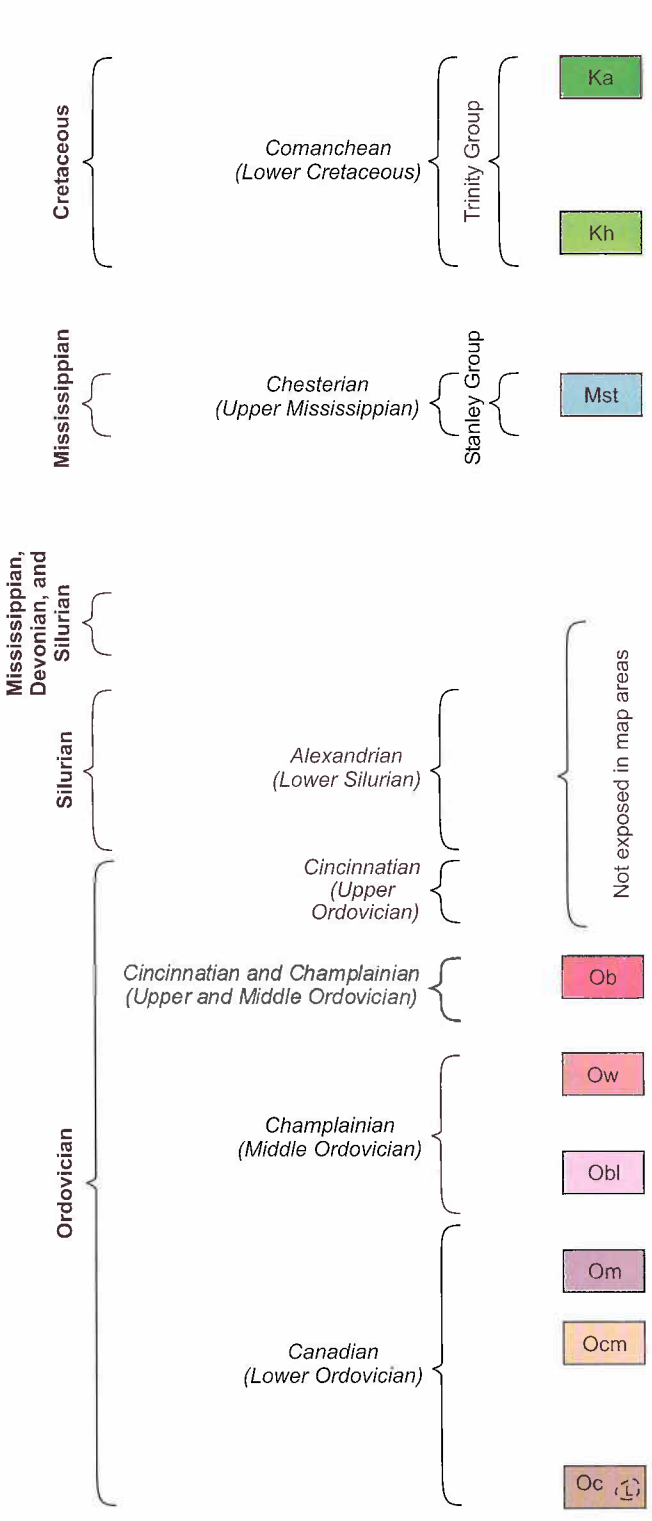
ORE DEPOSITS

The Ouachita core area can be subdivided into three mining districts, termed Carson, Bellah, and Buffalo (Fig. 1). The host rock in the Carson District is the Lower Ordovician Collier Formation, consisting of dark-gray phyllite, quartzite, and marble. The host rock in the other two districts is the Tenmile Creek Formation, the lower division of the Stanley Group, composed of olive-gray to dark-gray shales and phyllites and tan quartzites, with the Battiest Chert Bed in the middle of the Tenmile Creek. The ores in the Bellah District occur above the Battiest, and those in the Buffalo District occur below.

All of the prospects and mines were developed in fissure veins, composed of fractured and brecciated quartz veins along steep faults that generally strike east–west. All of the known quartz veins occur east of a northeast–southwest-slanting line that extends from sec. 16, T. 4 S., R. 20 E., Pushmataha County, to sec. 28, T. 1 N., R. 26 E., Le Flore County.

Most of the mines and prospects are small. The largest (Davis) is 0.5 mi long, 208 ft deep, and 40 ft wide. Many veins could not be traced more than 20 ft from the prospect pit. Early prospectors looked for quartz veins with limonite termed the "iron hat." If pyrite or copper minerals were found, the prospector dug deeper for sphalerite and galena.

The main minerals are chalcopyrite ($CuFeS_2$), galena (PbS), and sphalerite (Zn,Fe)S, associated with quartz (SiO_2), calcite ($CaCO_3$), siderite ($FeCO_3$), pyrite (FeS_2), barite ($BaSO_4$), celestite ($SrSO_4$), ankerite $CaCO_3 \cdot (Mg,Fe,Mn)Co_3$, and hematite ($Fe_2O_3$). Anglesite ($PbSO_4$), cerussite ($PbCO_3$), and covellite (CuS) have been reported from Arkansas. The oxidized minerals are malachite $Cu_2(CO_3)(OH)_2$, azurite $Cu_2(CO_3)(OH)_2$, calamine or hemimorphite $Zn_4Si_2O_7(OH)_2 \cdot H_2O$), and limonite (brown hydrous iron oxide). Silver occurs in argentiferous galena, generally in quantities <66 ppm (<2 oz silver per ton of mixed ore). Gold is absent but has been reported in Arkansas. Titanium and manganese may occur in quantities >0.2%. Chromium, cobalt, molybdenum, nickel, tin, and vanadium are present in amounts generally <20 ppm. Tetrahedrite $Cu_3(Sb,As)S_3$ occurs in the Arkansas mines, and silver, zinc, iron, and mercury may replace some of the copper. Thus, some antimony and mercury has been reported from the Davis and Bellah Mines of Arkansas, in addition to gallium, selenium, arsenic, uranium, rubi-



EXPLANATION

Antlers Formation Sandstone and conglomerate, orange-brown, tan, gray, white, fine- to coarse-grained, weakly indurated, with some shale and limestone; unconformable upon Ouachita rocks; top eroded. Exposed thickness, 30 ft (9.1 m).

Holly Creek Formation Gravel, composed mostly of quartz and novaculite, with clay and silt, tan to red-brown; unconformable upon Ouachita rocks. Exposed thickness, 80 ft (24.4 m).

UNCONFORMITY

Tenmile Creek Formation Shale, dark-olive-green to gray, with many poorly sorted quartzose, micaceous, fine- to very fine-grained sandstone beds 5–20 ft; subdivided into two parts by the Battiest Chert Member (135 ft thick), which is gray to brown chert and sandstone; upper part is about 4,500 ft thick, and lower part is about 6,300 ft thick, with Hatton Tuff beds in lower 1,000 ft; base and top not exposed in mapped areas; thickness, about 11,000 ft (3,300 m). Contains zircons, 2.8 billion years old (Hutson and others, 1993).

Arkansas Novaculite Chert, variegated, gray, green, tan, black, white, and pink, with interbedded black to gray shale, thin-bedded; thickness, about 600 ft (183 m).

Missouri Mountain Shale Shale, greenish-gray, maroon, and black, gradational into phyllite, with some sandstone; thickness, 60–10 ft (18.3–33 m).

Blaylock Sandstone Sandstone, greenish-gray, fine-grained, well-indurated; thickness, about 800 ft (244 m).

Polk Creek Shale Shale and phyllite, gray to black, fissile, with many graptolites; thickness, 75–140 ft (22.8–43 m).

Bigfork Chert Chert, shale, limestone, and dolomite, gray to black, thin-bedded, eroding into a mappable ridge; lower part exposed only in mapped area; thickness, 800 ft (244 m).

Womble Formation Shale, phyllite, sandstone, and quartzite, gray, red-brown, micaceous, quartzose, fine-grained, weakly indurated; thickness, 1,000 ft (305 m).

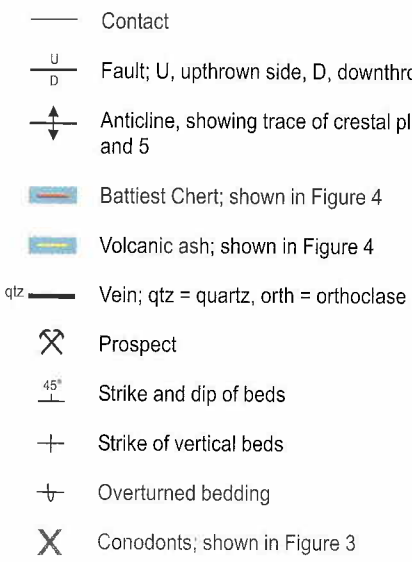
Blakely Sandstone Sandstone and quartzite, gray to brown, well-indurated, fine-grained, eroding into a ridge; thickness, 15 ft (4.6 m) or more.

Mazarn Shale Shale and phyllite, with some quartzite, dark-gray, weakly indurated; thickness, 1,000 ft (305 m).

Crystal Mountain Sandstone Sandstone and quartzite, gray, tan, and pink, fine- to coarse-grained, quartzose, clean, with basal 14-ft conglomerate containing reworked Collier pebbles; with many orthoclase and quartz veins, eroding into a ridge; thickness, 100–500 ft (30.5–152 m).

Collier Formation Limestone, marble, shale, phyllite, sandstone, and quartzite, dark-gray; weakly indurated; upper 200 ft exposed with lower part to Viersen marble penetrated in Viersen and Cochran well in sec. 25, T5S, R23E; thickness, 1,000 ft (305 m). Contains Upper Cambrian trilobites in Arkansas (Stitt and others, 1994). *L* indicates type "Lukfata" sandstone described by Pitt (1955).

Figure 2 *(above and facing page)*. Explanation to geologic maps.



Notes:

① Crystal Mountain Sandstone, with 14-ft conglomerate at base with 8-in. boulders of reworked Collier rocks; shown in Figure 3.

② Hydrothermal replacement vein of calcite and quartz; shown in Figure 3.

③ Precambrian metagrabbro olistolith (Morris and Stone, 1986), 2–10 ft thick, light-greenish-gray, medium- to fine-grained, quartz-free, with much andesine plagioclase and ferromagnesium minerals altered to chlorite and limonite; shown in Figure 3.

④ Viersen and Cochran 25-1 Weyerhaeuser well; shown in Figure 3; well abandoned 9/8/70. Elevation of kelly bushing, 526 ft. Total depth, 10,019 ft. Spudded in Collier black phyllite, quartzite, and marble. NW-NE-SE-NW sec. 25, T5S, R23E. Top Collier Formation, from surface outcrop nearby; elevation of top, +530 ft.

Viersen marble	–474
Phyllite, quartzite, and some chalcopyrite	–1,974
Marble and phyllite	–2,624
Robinson phyllite	–2,834
Quartzite and phyllite, with copper mineralization	–3,494
Recrystallized phyllite, with feldspar and magnetite	–6,474
Chlorite, metaquartzite, and feldspar, to bottom of hole	–7,724
Total depth	–9,493

⑤ Hunt Oil 26-1 Weyerhaeuser well; abandoned 1/5/99. Elevation, ground, 485 ft. Total depth, 16,930 ft. Spudded in Collier. Tight hole. NW-SW-NE sec. 23, T5S, R23E; shown in Figure 3.

Figure 2 *(continued).*

dium, strontium, zirconium, and yttrium. Approximately 26 samples were collected from the dumps or veins in June and July 1972. The samples were randomly collected and were not channel samples. David Foster (former analytical chemist with the Oklahoma Geological Survey) analyzed the samples in 1975, using the arc emission spectrograph for qualitative analysis and atomic absorption for quantitative analysis. The results are listed in Table 1.

The exact amount of ore produced from each mine is unknown, and the tenor of the ore is unknown. I have tried to summarize knowledge about each prospect and mine from examination of the literature and from talking with local residents. Probably no more than 450,000 short tons of ore and rock was excavated from all of the mines and prospects, of which probably 25,000 short tons was high-grade, crushed, concentrated ore. Most of this came from the Bellah, Buffalo, and Davis Mines and was shipped to Joplin, Missouri, for processing.

Carson District

The Carson District is named after the Kit Carson prospect and comprises 20 mi^2 of the Choctaw anticlinorium or core area in secs. 10–15, 22–27, T. 5 S., R. 23 E., and secs. 7–8, 17–20, 29–30, T. 5 S., R. 24 E., McCurtain County (Figs. 2, 3). Two prospects were mentioned by Honess (1923, p. 39–40). Galena and sphalerite occur in the Collier Formation (Lower Ordovician), in quartz and calcite veins in dark-gray phyllite, quartzite, and marble. The Collier is tightly folded and faulted, below the Crystal Mountain Sandstone (= Cool Creek Formation), and is the approximate equivalent of the McKenzie Hill Formation of the Arbuckle Mountains.

The geology of the district is that of an overturned anticline, with steep northwestward dips on both flanks. The Choctaw anticlinorium covers ~100 mi^2 in T. 4–5 S., R. 23–25 E., comprising Middle to Lower Ordovician rocks below the Bigfork Chert. Honess (1923) and Pitt (1955) mapped the core area, and Dunagan (1976) remapped 12 mi^2 in T. 5 S., R. 24 E. Each map is different. I tried to adapt Honess's map to topography and to modify that map following Pitt and Dunagan, plotting the geology on the Golden topographic quadrangle (scale 1:62,500). The named units in the district are (in descending order): Womble Formation (1,000 ft), Blakely Sandstone (15 ft or more), Mazarn Formation (1,000 ft), Crystal Mountain Sandstone (500 ft), and Collier Formation (1,000 ft). The Womble is mainly a dark-gray phyllite with much quartzite, the Blakely is a brown sandstone, the Mazarn is phyllite and marble, the Crystal Mountain is a clean pink to gray course-grained quartzite, and the Collier is marble and phyllite with some quartzite similar to the Crystal Mountain. A 14-ft conglomerate occurs at the base of the Crystal Mountain Sandstone, with quartz, argillite, shale, and Collier limestone and chert pebbles as much as 8 in. in diameter. Repetski and Ethington (1977, p. 92–106) studied two conodont faunas in the core area, concluding that the one collection from the NW¼NE¼ sec. 17, T. 5 S., R. 24 E., is Mazarn and that the other from the NW¼NE¼ SW¼ sec. 18, T. 5 S., R. 24 E. is Collier. In Arkansas, Upper Cambrian trilobites occur in the Collier (Stitt and others, 1994).

The oldest exposed rock in the core area consists of ~200 ft of the Collier Formation. The only information about rocks older than the Collier is that of the Viersen

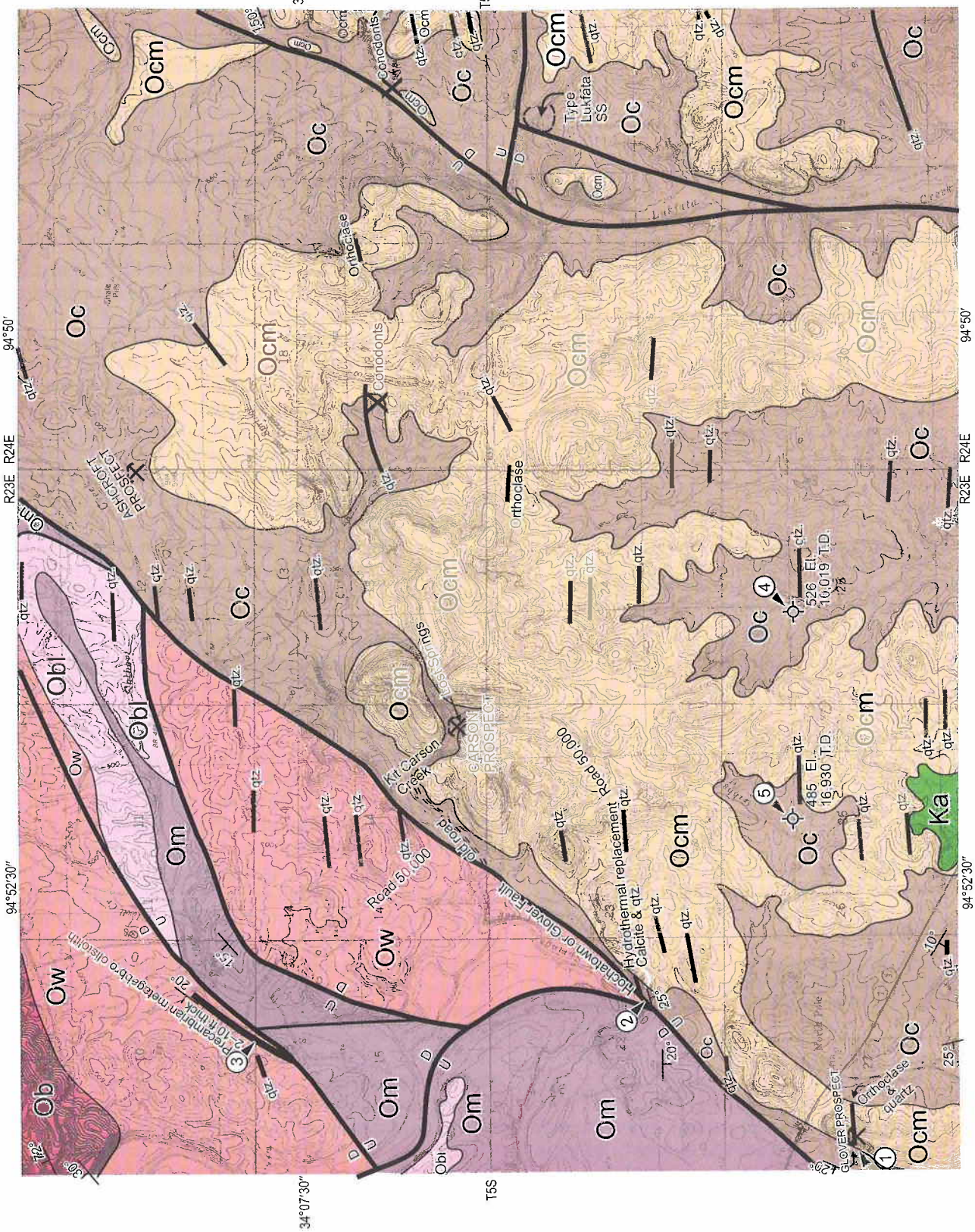


Figure 3. Kit Carson prospect area, T. 5 S., R. 23 E., McCurtain County, Oklahoma.

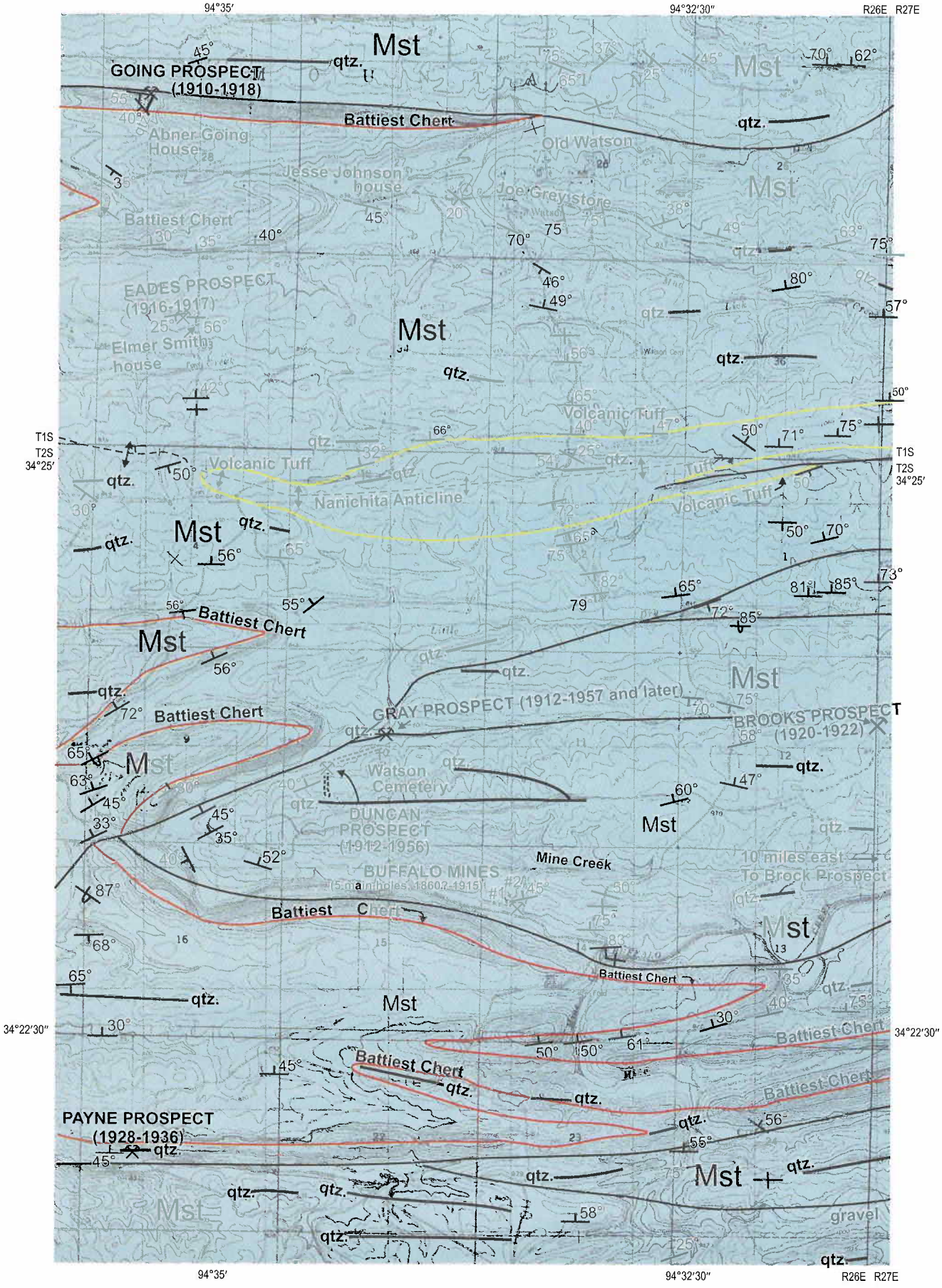


Figure 4. Buffalo Creek area, Ts. 1–2 S., R. 26 E., McCurtain County, Oklahoma.

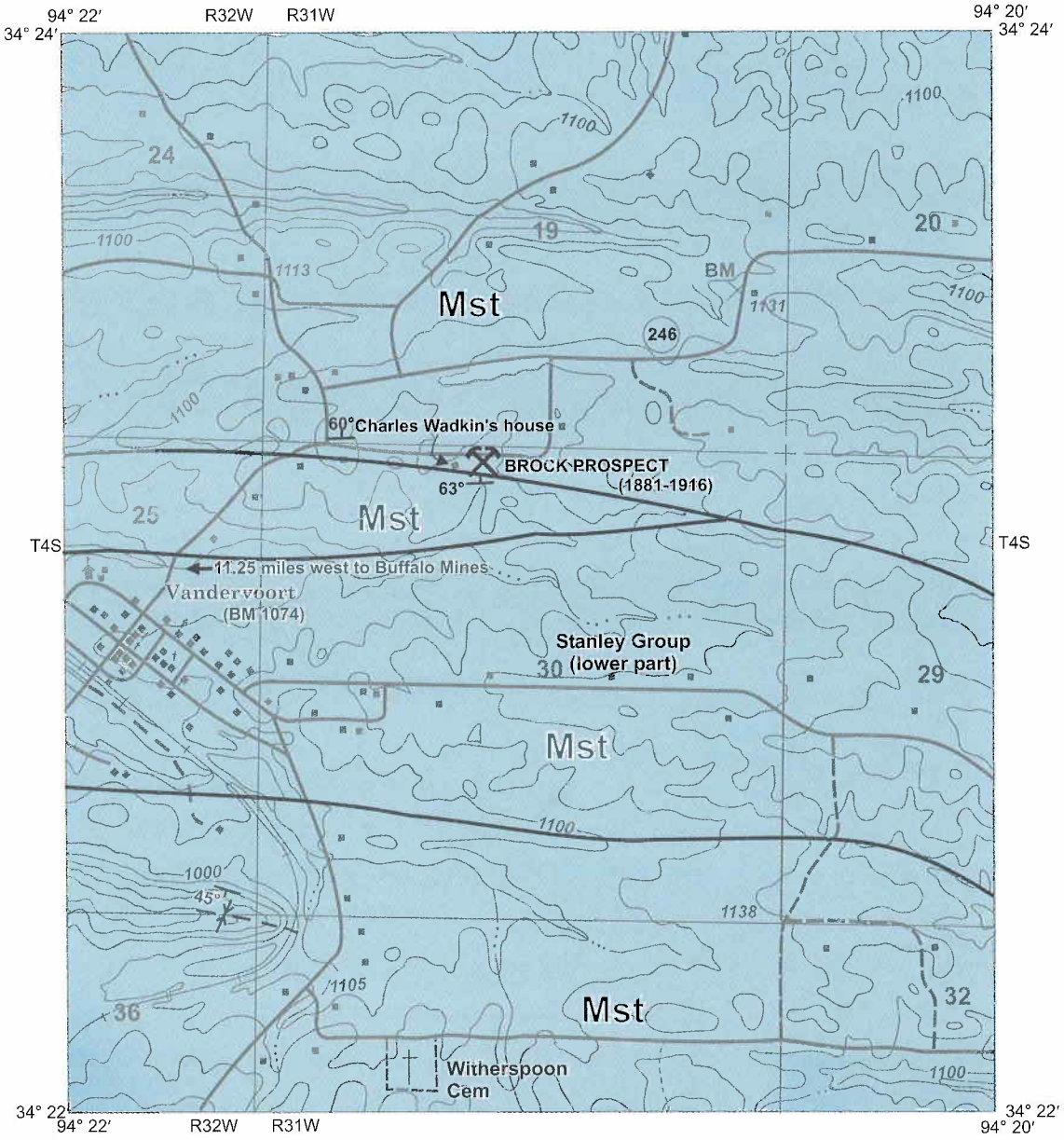


Figure 5. Vandervoort area, T. 4 S., Rs. 31–32 W., Polk County, Arkansas.

and Cochran 25-1 Weyerhaeuser well, 720 ft east and 266 ft south of the center of the NW¼ sec. 25, T. 5 S., R. 23 E., completed September 8, 1970, to a total depth of 10,019 ft (at an elevation of 526 ft). Goldstein (1975, p. 167–181) examined the cores and thin sections, and summarized the knowledge of this test (Fig. 2 [note 4] and Fig. 3). The following column is modified after Goldstein:

	Elevation of top (ft)
Collier Formation (phyllite, quartzite, marble) (1,004 ft)	+530
Viersen Marble (1,500 ft)	–474
Unnamed phyllite, quartzite, with chalcopyrite (650 ft)	–1,974
Unnamed marble and phyllite (210 ft)	–2,624
Robinson Phyllite (660 ft)	–2,834
Unnamed quartzite, phyllite, with copper mineralization (2,980 ft)	–3,494
Recrystallized phyllite, with feldspar and magnetite (1,250 ft)	–6,474
Unnamed chlorite metaquartzite with feldspar, and phyllite (1,769 ft)	–7,724
Total depth (10,019 ft)	–9,493

All of the units contain quartz and calcite veins. All of the surface units contain quartz veins that strike E–W, and the Collier and Crystal Mountain have orthoclase veins in addition. In July 1987, Sohio Petroleum Company abandoned the No. 1-22 Weyerhaeuser well at 18,986 ft, in SW¼NW¼NE¼ sec. 22, T. 5 S., R. 24 E., (el-

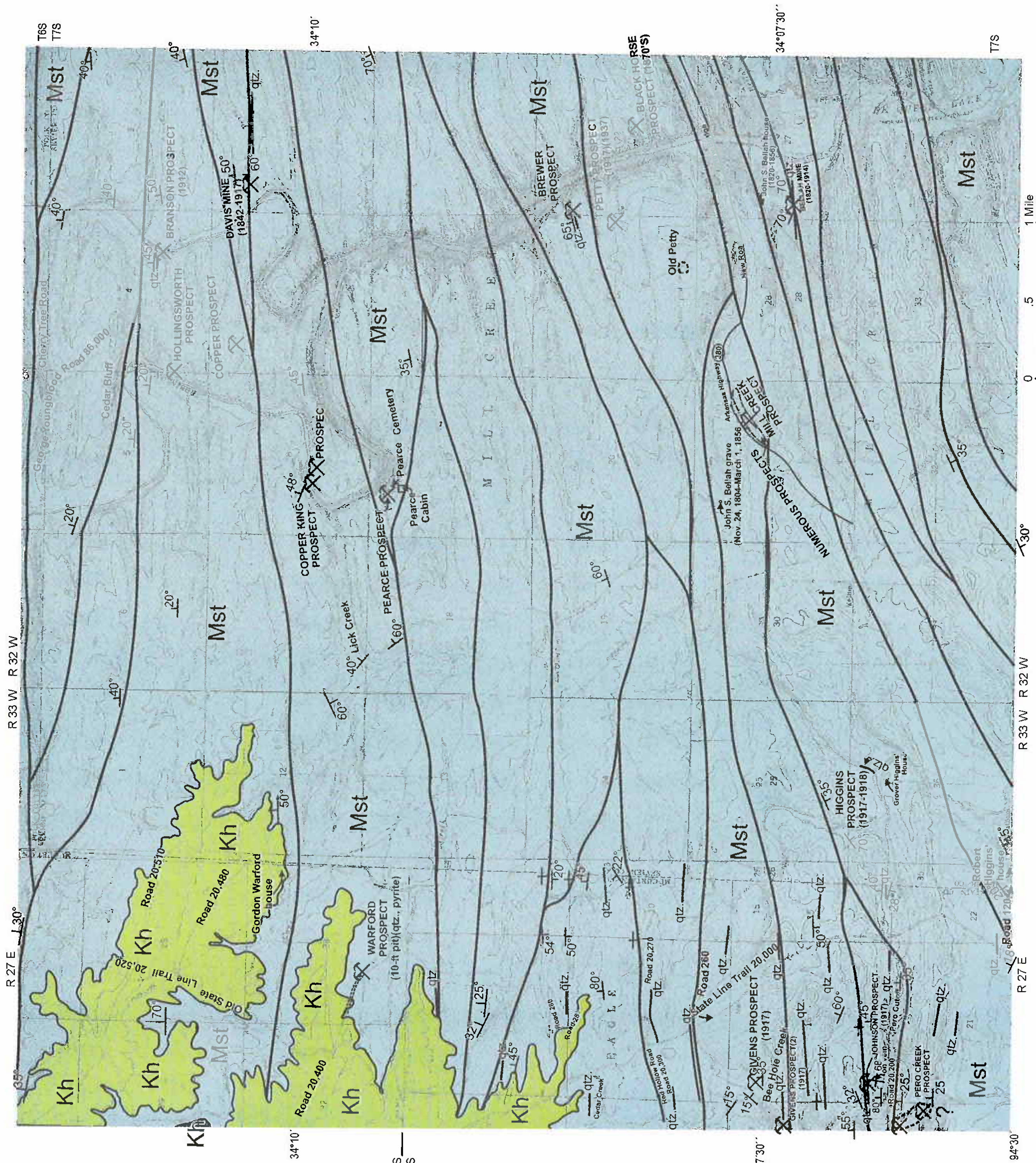


Figure 6. Bellah area, Ts. 4–5 S., R. 27 E., McCurtain County, Oklahoma, and T. 7 S., Rs. 32–33 W., Sevier County, Arkansas.

TABLE 1.—Spectrographic and Atomic Absorption Analyses

Sample no.	Spectrographic analysis (ppm except where % is given)												
	Ag	Al	Au	Ba	Ca	Co	Cr	Cu	Fe	Ga	Ge	Mg	Mn
Collier													
1	—	>1%	—		>1%	<10	—	200–666	>2,000		—	>1%	666–2,000
2	—	>1%	—		>1%	—	—	20–66	>2,000			>1%	>2,000
3	—	>1%	—	—	>1%	—	<20	200–666	>2,000			>1%	>2,000
4	<20	>1%	—		>1%	<20	—	<20	>2,000			>1%	66–200
Arkansas Novaculite													
5	—	>1%	—		200–666	—	—	<20	>2,000			>2,000	666–2,000
Stanley													
6	<20	>1%	—		>2,000		—	200–666	>1%			>1%	20–66
7	<20	>1%	—		>2,000	<20	<20	<20	>2,000			>2,000	200–666
8	<20	>1%	—		>1%	—	<20	66–200	>1%			>2,000	>2,000
9	<20	>1%	—	—	>2,000	<20	<20	200–666	>2,000			>2,000	200–666
10		>1%	—		>1%	<20	<20	200–666	>2,000			>2,000	>2,000
11	—	>1%	—	>2,000	>1%	<20	<20	<20	>2,000			>2,000	>2,000
12	<20	>1%	—		>1%	<20	—	<20	>2,000			>1%	20–66
13	<20	>1%	—		>2,000	<20	<20	200–666	>1%			>1%	>2,000
14	<20	>1%	—		>1%	—	—	200–666	>2,000			>2,000	>2,000
15	<20		—		>2,000	—	<20	<20	>2,000			>2,000	666–2,000
16	<20	>1%	—		>1%	<20	—	200–666	>2,000			>2,000	666–2,000
17	<10	>1%	—			—		200–666	>2,000		—		200–666
18	<20	>1%	—		>2,000	<20	<20	>2,000	>1%			>2,000	200–666
19	—	>1%	—		>1%	—	—	>2,000	>2,000			>1%	>1%
20	20–66	>1%	—		>2,000		200–666	>2,000			—	>2,000	666–2,000
21	20–66	>1%	—		666–2,000		20–66	>2,000			—	>2,000	66–200
22	<10	>1%	—				—	>2,000	>2,000		—	>2,000	66–200
23	20–66	>1%	—		>2,000	<10	—	>2,000	>2,000		—	>1%	200–666
24	—	>1%	—		>1%	—	—	66–200	>2,000		—	>1%	>2,000
25	—	>1%	—		>2,000	—	—	200–666	>2,000		—	>1%	200–666
26	—	>1%	—		>1%	—	—	20–66		—	—	>1%	666–2,000

NOTE: A dash (—) means looked for but not found. Hbg = high background.

of Selected Ore Samples from the Ouachita Mountains

Spectrographic analysis (ppm except where % is given)											Atomic absorption (%)			
Mo	Na	Ni	Pb	Pt	Si	Sn	Sr	Ti	V	Zn	Cu	Pb	Zn	Sr
—		—	>2,000		>1%			>2,000	—	>2,000	0.06	0.20	0.98	
<20		—	<20		>1%		200–666	>2,000	—	>2,000	<0.01	<0.01	4.38	
<20		<20	66–200		>1%		Hbg	>2,000	<20	>2,000	0.02	<0.01	11.20	
<20		<20	<20		>1%	<20	>2,000		<20	20–66				
—		—	—		>1%		—	<33	—	—				
—		—	>2,000		>1%		>2,000	666–2,000	<20	>2,000	0.02	1.37	3.77	
<20		<20	>2,000	—	>1%	<20	>2,000	>2,000	20–66	>2,000	<0.01	0.45	1.68	0.08
<20		—	>2,000		>1%		—	>2,000	<20	>2,000	0.015	26.25	0.99	
<20		<20	>2,000		>1%		—	>2,000	20–66	<200	0.02	4.21	0.01	
—		<20	>2,000		>1%		666–2,000	>2,000	<20	>2,000	0.03	1.19	0.96	
—	>2,000	<20	>2,000		>1%		>2,000	>2,000	20–66	<200	<0.01	0.31	0.01	
<20		<20	<20	—	>1%	<20	>2,000	>2,000	<20	<200				
—		<20	>2,000		>1%		>2,000	>2,000	<20	>2,000	0.04	2.02	0.65	
—		—	>2,000		>1%		>2,000	>2,000	20–66	>2,000	0.03	1.50	0.30	
<20		<20	20–66	—	>1%	<20	Hbg	20–66	<20	<200				
<20		<20	>2,000		>1%	—	Hbg	>2,000	<20	200–666	0.02	0.80	0.02	
		66–200	66–200		>1%	—				666–2,000				
<20		<20	666–2,000		>1%		—	666–2,000	<20	>2,000	4.12	0.20	0.99	
—		66–200	<200		>1%			666–2,000	—	200–666	0.22		0.03	
—		200–666	>2,000		>1%			>2,000	200–666	>2,000	0.42	0.76	0.09	
—		200–666			>1%			666–2,000	66–200	>2,000	1.60	1.10	0.21	
		20–66	>2,000		>1%	—		>2,000		>2,000	0.51	0.46	10.80	
—		—	>2,000					>2,000	—	>2,000	0.72	2.78	0.78	
—		—	<200		>1%			666–2,000	—	666–2,000				
—		—	—		>1%			>2,000	—	—				
—		—	—		>1%			200–666	—	—				

evation 656 ft, D. F.), with carbonates at 11,714 ft to total depth and reflectance values of 7–8%. In January 1999, Hunt oil Company abandoned the no. 1-26 Weyerhaeuser well at 16,930 ft, in NW¼SW¼NE¼ sec, 26, T. 5 S., R. 23 E. (elevation 485 ft, ground level). No information on minerals was reported. Both wells were spudded in the Collier (Fig. 2 [note 5] and Fig. 3). Honess (1923, p. 210–212) described a diorite sill in the Womble, about 750 ft south of the north quarter corner of sec. 15, T. 5 S., R. 23 E., extending about 0.5 mi northeastward, exposed on the west side of Colbert Creek in sec. 10. In 1986, this was found to be a Precambrian metagabbro olistolith (Morris and Stone, 1986) (Fig. 2 [note 3] and Fig. 3). Mitchell (1922) discovered an igneous dike in the Stanley 7 mi east of Gillham, Sevier County, Arkansas, in the SE¼ sec. 9, T. 7 S., R. 30 W.

John A. Veeder of the Oklahoma Geological Survey reported on March 24, 1936 (field sheet 129, laboratory no. L 7235) a replacement deposit in the SW¼NE¼SE¼ sec. 22, T. 5 S., R. 23 E. (Fig. 2 [note 2] and Fig. 3):

> On the southeast side of Glover Creek in the steep bluffs, the Womble and Collier formations are exposed. The escarpment is exposed precipitously for one hundred and fifty feet in which hydrothermal replacements were found to occur in the lower exposed beds. The replacements were not confined to any definite horizon and varied in thickness from eight inches to small fissures. The deposits consisted chiefly of calcite in some instances dissolved to a brownish color in direct association with milky quartz. No mineralization was found to be associated from megascopic analyses. The formation where this occurrence was found dips to the southwest at an angle of twenty to twenty-five degrees. Sample #129-1.

No analysis was given.

In addition to copper, lead, and zinc, the samples from the Collier contain minor amounts of silver, cobalt, chromium, manganese, molybdenum, nickel, tin, titanium, strontium, and vanadium.

Carson Prospect

The Kit Carson prospect is on Kit Carson Creek in the NW¼NE¼SE¼SE¼SE¼ sec. 14, T. 5 S., R. 23 E., McCurtain County (Figs. 2, 3, 7). It is a few hundred feet west of two old springs termed Lost Springs. A new logging road passes within 100 ft northeast of the prospect. Some mineralization has been found in the new rock cuts along the road on strike with the Carson prospect, and some galena has been found higher up, above the creek about 50 ft (Fig. 8).

The prospect is a trench and hole about 25 ft deep in a 2-ft quartz-and-calcite vein in the Collier Formation, in the bed of the creek. The vein strikes N. 75° E. and dips 50° NW., and the Collier phyllite strikes N. 40° E. and dips 15° NW. The Collier is composed of dark-gray dolomitic and calcitic marble, quartzite, and phyllite ~1,000 ft thick. It is tightly crumpled and in many places overturned.

The earliest reference to this prospect is that of Honess (1923, p. 39–40):

Figure 7. Kit Carson prospect, looking southwest, on Kit Carson Creek. Collier marble strikes southwest, with a small pit in the creek and a 20-ft cut on the southwest side of the creek. NW¼NE¼SE¼SE¼SE¼ sec. 14, T. 5 S., R. 23 E., McCurtain County, Okahoma. April 10, 1973.

Figure 8. New road cut on northeast side of Kit Carson prospect, looking northeast at fault zone in Collier, with dip to northwest. NW¼NE¼SE¼SE¼SE¼ sec. 14, T. 5 S., R. 23 E., McCurtain County, Oklahoma. April 10, 1973.

> A small pocket of galena, sphalerite, and chalcopyrite associated with calcite and quartz was found in the creek bed in the SE¼SE¼ sec. 14, T. 5 S., R. 23 E., near Lost Springs. The minerals are vein materials in the Collier shale occupying a zone two or three feet wide striking northeast, but the mineralization seems to be very local and the vein could not be followed out of the creek bottom.

John A. Veeder of the Oklahoma Geological Survey reported on March 3, 1936 (field sheet 95, laboratory no. L-6373, McCurtain County):

> In the SE¼SE¼ of Section 14, approximately four miles north of Glover and a mile east of Glover Creek,

on a small branch called Kit Carson Creek, a prospect of ore has been made. This deposit is situated about 0.4 of a mile southeast of the road near two old springs called Lost Springs. In the creek bed small amounts of lead, copper, and zinc sulphides were first detected. They were traced to a vein of quartz coming to the surface in the creek bed with a thickness of approximately two feet, in the calcareous black dense strata of the Collier formation. A shaft had been sunk to a depth of twenty-five feet in an attempt to find a further enrichment of ore at a greater depth. Crystals of pyrite, galena, and sphalerite, the latter apparently most abundant, appear in segregated cavities and stringers in association with the quartz vein and surrounding limestone country rock. Crystals of calcite were found in association with the weathering product of the feldspar contained. The calcite undoubtedly was obtained from the calcareous country rock. Endeavors were made to trace the vein on either side of the locality where it was exposed to the surface without success, the mineralization undoubtedly being of local extent. The general trend of the vein is northeast–southwest with the country rock consisting of the Collier Limestone which dips to the northeast at a moderate degree of ten to fifteen degrees. Northwest of the main shaft one hundred yards downstream another hole had been sunk in an effort to uncover the vein of mineralization without any traces of this vein being found. These holes are at the present filled with water. Samples of the ore with country rock were obtained for further study. Sample #95-1.

No analysis is given, except that the material was lead, copper, and zinc sulfides. Veeder spelled the name "Karson," but it should be "Carson" if the creek was named after Christopher Kit Carson (1809–1868).

I collected samples from the vein on June 7, 1972, and I also found some galena about 50 ft up the hill to the northeast. David Foster analyzed the three samples on June 30 and December 4, 1975. The results are listed in Table 1 (sample nos. 1–3, the first two being from the creek and the last being from the hill).

Ashcroft Prospect

The Ashcroft prospect is 250 ft south of the east quarter corner of sec. 12, T. 5 S., R. 23 E., McCurtain County (Figs. 2, 3). It is 200 ft west of the new Bob Ashcroft road, after whom the prospect is here named. Some thin quartz veins were noted in the Collier Formation, with some sphalerite in calcitic and dolomitic marble and dark-gray phyllite, apparently flat-lying. I was unable to find a pit or adit.

The earliest reference to this occurrence is that of Honess (1923, p. 40):

> A few sphalerite crystals were noted in the Collier limestone 100 paces south of the E¼ cor., sec. 12, T. 5 S., R. 23 E. These were very small and very sparsely distributed through the limestone.

I collected some spot samples from this outcrop on July 18, 1972. David Foster analyzed the samples on December 4, 1975. The results are listed in Table 1 (sample no. 4).

Glover Prospect

The Glover prospect is in the CNW¼SW¼ sec. 27, T. 5 S., R. 23 E., McCurtain County (Figs. 2, 3). It is about 0.25 mi west of North Pole, on the steep east bank of the Glover River, after which it is here named. The only reference to this prospect is that of John A. Veeder (March 19, 1936, Oklahoma Geological Survey field sheet 128, McCurtain County):

> In the west quarter of section 27, a two-foot dike of milky quartz was intruded in the limestones and slates of the Collier formation. Prospecting had taken place along several locations as it was followed from the east bank of Glover Creek northeastward, with very little mineralization if any having taken place.

Honess (1923) mapped one orthoclase-and-quartz dike in the hillside at this locality, and it is presumed to be the approximate location of the prospect. I did not visit the locality.

Buffalo District

The Buffalo District is named after the Buffalo Mines that were supposedly opened by Spanish settlers before the Civil War. The area covers 24 mi^2, including secs. 25–28, 33–36, T. 1 S., R. 26 E., and secs. 1–4, 9–16, 21–24, T. 2 S., R. 26 E., McCurtain County, Oklahoma (Figs. 1, 2, 4, 5). Eight prospects and mines have been named in the district. The Brock prospect in Arkansas is on strike with the Buffalo Mines, about 0.25 mi north and 11.5 mi east of the Buffalo Mines, and is included in the district but treated as a separate mapped area (Figs. 1, 5). The Brock and Payne prospects probably occur along the same fault system.

The early history of the area is lost, but the Spanish diggings were supposedly ~25 ft deep. Some fish hooks and "Indian" relics carved from lead have been found in the bottom country near Hochatown, McCurtain County (T. 4 S., R. 25 E.), according to Alma Beavers, a daughter of "Uncle Johnny Beavers," after whom Beavers Bend State Park is named. She said (in 1972) that these relics were found by farmers who plowed their fields along the Mountain Fork River bottoms. The closest reported prospect is the William Oakes prospect (1880), a 4- × 5-ft pit about 50 ft above Mountain Fork at The Narrows, on the east side of the river, in the NE¼SE¼SW¼ sec. 9, T. 2 S., R. 25 E., McCurtain County. The pit was dug in rocks of the lower Jackfork Group ~1,000 ft above the Chickasaw Creek Chert at the base of the Jackfork. The beds dip about 38° SW. Some silver was supposed to have been found. Malcolm Oakes of the Oklahoma Geological Survey stated that William Oakes was his uncle and that he was unable to confirm any mineralization from this prospect. I was unable to find the pit. The next closest source of lead would have been the Buffalo Mines, and it is possible that these were known to the Indians for hundreds of years. Lead was not supposed to have been smelted by the Indians, so it is possible that these Hochatown relics are early French or Spanish.

The geology of the district is dominated by tightly folded and faulted rocks of the middle Stanley Group that strikes E–W. The Stanley consists mostly of dark-gray phyllites and shales and tan quartzites and sandstones ~11,000 ft thick, with the Battiest Chert near middle. All of the prospects are ~1,000 ft or less below the Battiest Chert, occurring along brecciated quartz veins in faults.

The total production from the district was probably <5,000 tons of mixed ore and rock. Most of the ore was supposedly shipped to Cove, Arkansas. Most of the mining ceased about 1920.

Buffalo Mines

The Buffalo Mines consist of at least five pits in the NE¼SW¼NW¼ sec. 14, T. 2 S., R. 26 E., McCurtain County, Oklahoma (Figs. 2, 4). These lie along a small south-flowing stream termed Mine Creek and on the hillside west of the stream. The mines are reached by a trail from the east, bearing south at the fork about 0.25 mi west of the main Watson road. One pit is near the mouth of Mine Creek, on the east side, just north of Buffalo Creek. Another hole is on Mine Creek about 150 ft north of the mouth, and a third hole (Fig. 9) is in the creek about 250 ft north of the mouth. The two old main shafts are about 150 ft north of Buffalo Creek and 100 ft west of Mine Creek (Fig. 10). The oldest shaft (no. 1; Fig. 11) is supposed to be the farthest one to the southwest, supposedly dug before the Civil War by early Spanish miners. Smith (1959, p. 371) mentions that in 1719 Benard de la Harpe was told by the Caddo Indians about Spanish mining in the Ouachitas about 40 leagues north of their village on the Red River. Morse (1805, p. 764) made a similar comment. A subsequent shaft (no. 2; Fig. 12), about 50 ft northeast of the older shaft, was supposedly dug about 1907, by a Dr. Nelson of Cove, Arkansas. He was a local medical doctor well known throughout the region. He also supposedly dug the other shallow pits to the east along the creek, and all of these miners were termed the Nelson Mines. The earlier shaft was about 25 ft deep before 1860. The later shafts were less than 90 ft deep. Another Mine Creek occurs on the south side of Buffalo Creek, but no mining occurred along this much larger creek, and another name should have been used for that creek.

Figure 9. Buffalo Mine on Mine Creek, looking north, about 250 ft north of Buffalo Creek. Stanley phyllite and quartzite strikes N. 40–60° E., and dips 45° NW. NE¼NE¼SW¼NW¼ sec. 14, T. 2 S., R. 26 E., McCurtain County, Oklahoma. April 11, 1973.

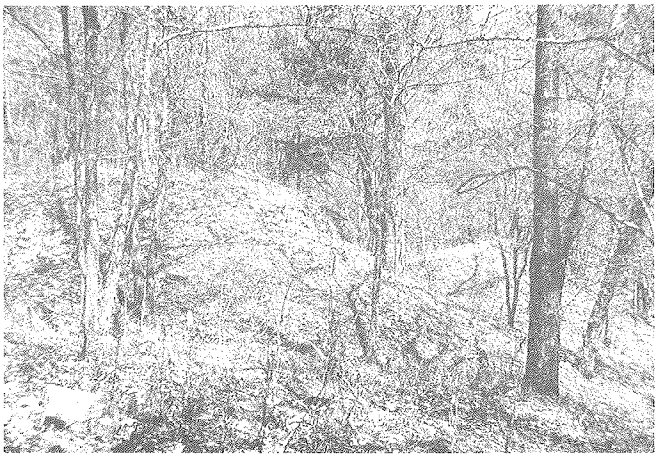


Figure 10. Buffalo Mine tailings, looking north at pit no. 1 tailings in foreground, and pit no. 2 tailing in background, about 50 ft northeast of pit no. 1 tailings. About 150 ft southwest of hole in creek in NE¼NE¼SW¼NW¼ sec. 14, T. 2 S., R. 26 E., McCurtain County, Oklahoma. April 11, 1973.

The earliest reference to this area is that of Honess (1923, p. 36–38):

> At a point about four miles south of Watson (600 paces south and 350 paces east of the NW. cor., sec. 14, T. 2 S., R. 26 E.) two shafts have been sunk upon a fractured zone of black siliceous shale and hard blue quartzite of the Stanley shale formation, locally containing lead and zinc sulphides. The two shafts are located in the southeast corner of an old abandoned field on the north side of a small creek which enters Buffalo Creek 60 paces to the south. Owing to their proximity to Buffalo Creek, the workings are known as the Buffalo Mines.
>
> It is stated by cattle men in the vicinity that Spanish settlers first worked the deposits from an open pit 25 feet deep, and that later (about 1907) this old pit was deepened by machinery to a depth of 80 feet and finally abandoned.
>
> Forty feet to the east of the older and deeper shaft is a second one 60 to 70 feet deep opened at a somewhat later date (the exact time not known) and abandoned in 1915.
>
> It is reported that considerable ore has been taken from these two shafts, but there was no ore in sight at the mines and both shafts were full of water when visited by the writer in 1917. No one seems to have any knowledge of the character or extent of the underground workings, the richness of the ore or width of the vein or brecciated zone. A large amount of rock has been taken from the shafts and is now piled upon the mine dumps. This material is largely dark gray quartzite and dark siliceous shale, portions of which are brec-

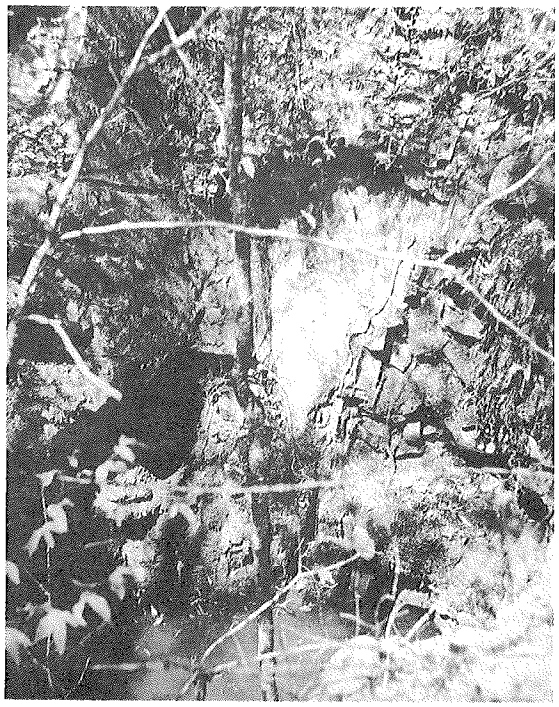


Figure 11. Buffalo Mine, pit no. 1. View looking north and obliquely downward, with water 20 ft down in 10- × 10-ft pit. Strike, N. 40° E.; dip, 45° NW. Stanley phyllite and quartzite, in NE¼NE¼SW¼NW¼ sec. 14, T. 2 S., R. 26 E., McCurtain County, Oklahoma, on west side of Mine Creek. April 11, 1973.

Figure 12. Buffalo Mine, pit no. 2, 50 ft northeast of pit no. 1. View looking north and obliquely downward, with water 20 ft down in 10- x 10-ft pit. Strike, N. 40° E.; dip, 45° NW. Stanley phyllite and quartzite, in NE¼NE¼SW¼NW¼ sec. 14, T. 2 S., R. 26 E., McCurtain County, Oklahoma, on west side of Mine Creek. April 11, 1973.

ciated and the fragments cemented with silica, calcite, and the sulphides. Several specimens of the brecciated materials containing sulphides were picked up. In most cases these are firmly cemented with finely crystalline quartz in such manner that they are virtually quartzites. In all cases observed the original fragments are completely surrounded by a thin veneer of very fine quartz, but in some instances sphalerite and galena are associated with the quartz in increasing quantities away from the original fragments of the breccia, indicating the order of precipitation to be (1) quartz and (2) galena and sphalerite. The fragments of original rock are not replaced by the sulphides. Veins of carbonate are very common. These in all cases intersect the original silicified breccia and the sulphides, and are clearly of later date. They themselves carry neither galena nor sphalerite, but crystals of pyrite may be seen associated with the calcite in some specimens where they sit on calcite and are apparently later in origin than most of the calcite.

One specimen (No. 421) is a massive fine grained, dark grey quartzite carrying disseminated sphalerite, galena, and pyrite and thin veins of calcite. The rock has been slickensided and there are polished surfaces developed on the pyrite, sphalerite, and calcite showing that there has unquestionably been some movement subsequent to the mineralization. Sphalerite estimated to amount to 15 per cent of the rock is the most abundant sulphide. In thin section the rock is seen to be finely brecciated and the fragments saturated and cemented with silica. The sphalerite, occurring in large and small, ragged, irregular grains and fine specks, is intimately interwoven with the quartz and apparently is contemporaneous with it in origin. The calcite occurring in veins is of later date. The pyrite and galena do not happen to show in the thin section.

There appears, therefore, in sum, to have been three periods of brecciation; the first followed by an introduction of quartz, galena, and sphalerite; the second by calcite and pyrite; the third is known only from slickensided surfaces developed on all the other minerals. In [a diagram shown in this report], the relative position of the individual mineral plats indicates the order (from left to right) of the deposition of the minerals, their length represents the duration of the deposition while the vertical dimensions of the individual plats indicate the estimated relative amounts of the respective minerals present in the sulphide bearing rock.

Stone and Milton (1976, p. 140–141) indicated that two periods of folding and faulting probably occurred, with quartz veins being formed during each episode. Most of the veins are probably Late Pennsylvanian to Early Permian in age, followed by Early Permian to Triassic mineralization. Howard (1979, p. 8–9) concurred with this opinion, stating that the ages of mineralization probably ranged between 214 and 307 m.y. following Bass and Ferrara (1969) and Denison and others (1977).

John A. Veeder of the Oklahoma Geological Survey recorded on May 18, 1936 (field sheet 172, laboratory no. 4614, McCurtain County):

NW¼ Section 14; An old mine site which has been called the Buffalo Mine was first said to have been worked seventy-five years ago by Spanish settlers. The site is located on the northwest side of a small creek, tributary to Buffalo Creek to the south. Spanish interests were supposed to have worked this mine from an open pit digging to a depth of twenty-five feet. At a much later date (1907) private interests had procured machinery extending this first open pit to a depth of eighty feet. At a still later date an adjoining shaft had been sunk seventy feet deep directly east of the original hole. The country rock in this area consists of quartzitic hard, blue sandstones and black siliceous slates of the Stanley formation of Pennsylvanian age. The two shafts were situated on a brecciated zone where the sandstone and slates had been badly fissured resulting in mineralization of lead and zinc sulphides associated with calcite and milky quartz. The mineralization zone appeared to extend in a general east to west direction although no leads could be traced in any direction from the original shafts. The country rock dips to the north with a 40 degree angle. Considerable quantities of zinc and lead are supposed to have been removed in the past. The shafts however are filled with water at the present time and very little mineral could be detected. Samples of country rock impermeated somewhat with spalerite and calcite were collected for observation. Very little galena was detected in the tailings from the mine. Sample #172-1. The analysis by Clifford Merritt shows no copper, lead, or zinc.

Hugh Dean of the Oklahoma Geological Survey reported on May 23, 1936 (field sheet 176, McCurtain County):

> The old Buffalo Mines, first worked by Spaniards seventy-five years ago is one of the oldest in the entire vicinity. This mine was first worked from an open pit and later machinery was used. The chief minerals procured were lead with considerable zinc associated. A total depth of seventy to eighty feet had been reached at this site. Because of limited concentration of mineral with depth further exploitation of this mine has ceased. For detailed report see Field Sheet No. 172.

Clifford Merritt, William E. Ham of the Oklahoma Geological Survey, and Joe Gray reported on August 6, 1941 (field sheet 0433, laboratory no. 8842, McCurtain County):

> The date of earliest working of this deposit is not known but local lore credits it to Spanish settlers. In 1907, some work was done. The workings are so old that shafts are slumped in, water filled, and the dumps have been picked over. The present dumps show very little metallic minerals, only a little sphalerite, galena, and chalcopyrite being noted. The present dumps are not an accurate picture of the original dumps or deposit. The country rock is dark-gray quartzite and dark siliceous shale, partly brecciated and cemented with quartz, calcite, and sulfides. See Honess [1923] for further details.

No analysis was given, but the mine was termed a zinc prospect.

The beds at the site are phyllites and quartzites of the Stanley Group, ~1,000 ft below the Battiest Chert. A prominent fault may occur along Buffalo Creek, where locally the beds are vertical to overturned, striking E–W in general (Fig. 13). At the mine site, the beds strike N. 40–60° E. and dip 45° NW. Less than 1,000 yards of rock was removed, or ~4,000 tons of mixed ore and rock.

I collected samples from along the creek on June 30, 1972, and these (Fig. 14) were analyzed by David Foster, December 2, 1975. The results are listed in Table 1 (sample nos. 13 and 14).

Brock Prospect

The Brock prospect (Figs. 2, 5, 15) is in the NE¼NE¼ NW¼ sec. 30, T. 4 S., R. 31 W., Polk County, Arkansas, about 6.5 mi east of the Oklahoma border, just northeast of Vandervoort, about 2 mi north of Hatton, east of U.S. Highway 59, seen on the Cove 7.5′ topographic quadrangle published in 1959. The prospect is 125 ft south of the half-section-line road and 350 ft east of Charles Wadkins's house, the owner since 1931. The prospect is on a branch of Little Hickory Creek, which drains westward into Buffalo Creek, and 11.5 mi east of the Buffalo Creek Mines in McCurtain County, Oklahoma.

According to Mr. Wadkins, the prospect was opened by a Mr. Brock in 1881. The shaft was 84 ft deep, with a short northeast drift at the base. Miser and Purdue (1929, p. 169) mentioned that another shaft was sunk in 1916, about 20 ft east of the old shaft. They visited the site in July 1916, but the new shaft was filled with water, and the old shaft was caved in.

The ore was mainly galena and sphalerite in a 5-ft quartz vein that strikes N. 80° E. and dips 65° N. The host rock is phyllite and sandstone in the lower part of the Stanley Group (Mississippian), below the Battiest Chert and above the Hatton Tuff. The region is intensely faulted, the main faults striking E–W. The Arkansas Novaculite crops out at Hatton, 2 mi to the south.

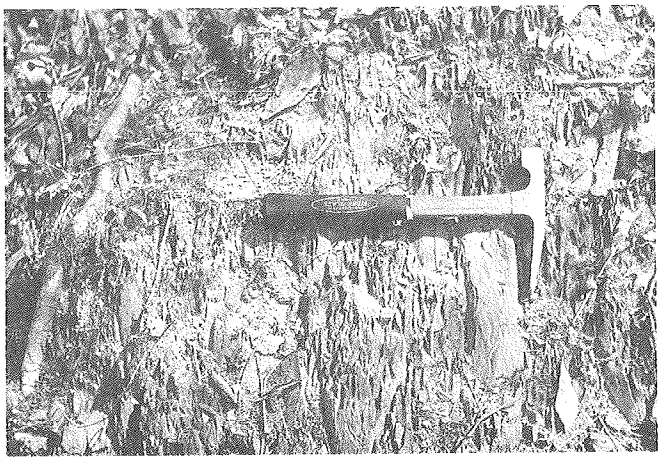


Figure 13. Buffalo Mine area. View looking northeast at Stanley phyllite and shale near fault on Mine Creek about 220 ft north of Buffalo Creek. Strike, N. 60° E.; dip, vertical. NE¼NE¼SW¼NW¼ sec. 14, T. 2 S., R. 26 E., McCurtain County, Oklahoma. April 11, 1973.

Figure 14. Buffalo Mine. Sphalerite and galena in brecciated quartz veins in Stanley phyllite and quartzite, on Mine Creek about 100 ft north of Buffalo Creek, in NE¼NE¼ SW¼NW¼ sec. 14, T. 2 S., R. 26 E., McCurtain County, Oklahoma. April 11, 1973.

I collected some samples from the dump on June 26, 1972, and these samples were analyzed by David Foster on December 2, 1975, using spectrographic and atomic-absorption analyses. The results are given in Table 1 (sample no. 16).

Brooks Prospect

The Brooks prospect is near the C west line of sec. 7, T. 2 S., R. 27 E., McCurtain County, Oklahoma (Figs. 2, 4). It is about 750 ft north of an old road. It was dug about 1920–1922 and is a 70-ft-deep shaft about 5 ft square. It is in a quartz vein in phyllite and quartzite of the Stanley Group, ~6,000 ft below the Battiest Chert. Pyrite occurs in quartz veins. The strike is E–W, and the dip is 58° N.

The only reference is that of Clifford Merritt and William E. Ham of the Oklahoma Geological Survey in company with Joe Gray (August 7, 1941, field sheet 0432, laboratory no. 8839, McCurtain County):

Figure 15. Brock Mine, near Vandervoort, Polk County, Arkansas. View looking south at log fence around water-filled shaft. Stanley shale dips steeply northward. NE¼NE¼NW¼ sec. 30, T. 4 S., R. 31 W. April 11, 1973.

This prospect working is known locally as the "Brooks" mine and the work was done 1920–1922, according to Mr. Joe Gray. The country rock is a fine crystalline, bluish-gray sandstone. The shaft was about 70 ft deep, but it now is partially slumped in and water filled. The dump has been picked over, and only quartz crystals and minute pyrite crystals and country rock are detectable with the unaided eye.

I collected some samples from the dump in July 1972, and these were analyzed by David Foster, December 4, 1975. The results are summarized in Table 1 (sample no. 12). Almost no minerals were seen on the dump.

Duncan Prospect

The Duncan prospect is in the SE¼NE¼NW¼SW¼ sec. 10, T. 2 S., R. 26 E., McCurtain County, Oklahoma (Figs. 2, 3, 16). It is about 50 ft east of a local road and consists of a hole 20 ft deep filled with water and a trench about 20 ft long northeast of the hole. The 50-ft-long quartz vein was first opened by John Harpending and associates about 1912, and the trench was dug later by a Mr. Duncan from Picher, Oklahoma, and Joplin, Missouri, about 1951–1956. Mr. Duncan died in 1956, and no one has worked the prospect since then. Mr. Jesse Johnson, the present owner, said that in the 1960s an airborne radioactivity survey was conducted, and a strong anomaly recorded in the area. Later, a ground crew determined that the 20-ft hole was the point source of the anomaly.

John A. Veeder of the Oklahoma Geological Survey visited the area and recorded his observations on June 1, 1936 (field sheet 184, laboratory no. 4619):

> A shaft twenty feet in depth had been sunk on the north flanks of a quartz and sandstone ridge of the Stanley formation. The country rock consisted of a gray, quartzitic, dense, hard sandstone which contained small seams and fissures of barite with small amounts of galena. Small crystals of sphalerite were found to be separately deposited in the sandstone unassociated with the barite and galena. Only small amounts of mineral were recovered from this prospect hole, the galena, sphalerite and barite being only sparingly distributed at the depth at which the hole was dug. On our visit the hole stood level in water. The country rock had a general east–west strike and dipped to the northwest with a forty degree angle. Samples were obtained. Sample #184-1.

Figure 16. Duncan prospect. View looking south at inclined adit. Stanley shale with quartz veins dipping 40° NW., in SE¼NE¼NW¼SW¼ sec. 10, T. 2 S., R. 26 E., McCurtain County, Oklahoma. April 11, 1973.

An analysis was given, but it failed to show copper, lead, zinc, or other metals.

The prospect is in quartz veins in phyllite and quartzite of the Stanley Group, ~1,000 ft below the Battiest Chert. The regional strike is N. 60° E., and the dip is 40–45° NW. The main minerals are galena, sphalerite, and barite (Fig. 17).

I collected samples July 14, 1972, and David Foster analyzed the samples December 3, 1975. The results are listed in Table 1 (sample no. 11).

Eades Prospect

The Eades prospect is in the NW¼SE¼SE¼NW¼ sec. 33, T. 1 S., R. 26 E., McCurtain County, Oklahoma (Figs. 2, 4, 18). The owner is Edsel Smith, and the prospect is about 100 ft north and 600 ft west of his house. According to Mr. Smith, the prospect was dug during 1916–1920 by Jake Eades. The main shaft is 126 ft deep, with one drift 30 ft long to the southwest at the 90-ft level, and one drift 10 ft long to the north at the 50-ft level.

The ore is mainly sphalerite in quartz veins in quartzites and phyllites of the lower Stanley Group, ~3,000 ft below the Battiest Chert and ~3,000 ft above a tuff bed. The Stanley beds strike E–W and dip 25–56°S. Several wagonloads of ore were taken to Cove, Arkansas, and shipped by rail in 1920.

The best information about this prospect is that of Honess (1923, p. 39):

> About 2 miles southwest of Watson in the SE¼ of the NW¼, sec. 33, T. 1 S., R. 26 E., a shaft has been sunk to a depth of about 40 feet in some dark slates and shales and interbedded blue quartzites of the Stanley formation. The rocks are badly shattered, probably through faulting, and contain sphalerite, barite, dolomite, quartz, and a slight amount of pyrie, all of which occur as vein materials in the shattered country rock. At the time of examination of the mine (Nov. 1917) about 3 tons of sphalerite had been taken from the shaft and placed in an ore bin, and about a half ton of barite had been piled to one side, but operations had ceased, and it was not possible to examine the rock below ground.
>
> Several specimens of the country rock and vein materials were collected from the dump, some of which are coarsely brecciated, dark, fine-grained sandstones cemented with finely cyrstalline quartz. The filling of the crevices is complete when the fissures do not exceed 3 mm. In excess of that width the fissures are not filled and their hollow centers bristle with the projecting points of tiny quartz and calcite crystals. Specimen 456-A is a massive, greenish-gray fine-grained, quartzitic sandstone cut by quartz and calcite veins. Where

Figure 17. Duncan prospect. Closeup view of sphalerite and galena in quartz veins in Stanley phyllite and quartzite. Vein strikes N. 60° E. and dips 40° NW., in SE¼NE¼NW¼SW¼ sec. 10, T. 2 S., R. 26 E., McCurtain County, Oklahoma. April 11, 1973.

Figure 18. Eades prospect. View looking west at filled-in rock area on hill, about 600 ft west of Edsel Smith house, in NW¼SE¼SE¼NW¼ sec. 33, T. 1 S., R. 26 E., McCurtain County, Oklahoma. Stanley Group was mined to a depth of 126 ft by Jake Eades. April 11, 1973.

the veins are thick, calcite occurs with the quartz, but if less than 3 mm. broad only quartz is found. Resting on quartz in a vug on one side of the specimen are several cubes and octahedra of pyrite.

From the materials collected it is clear that quartz was the first mineral to be precipitated on the broken fragments of country rock and that calcite followed later together with a little pyrite, but for want of better specimens it is not known what position the sphalerite and barite take in the order of precipitation.

The next information on the prospect is that of John A. Veeder, of the Oklahoma Geological Survey, who reported on May 11, 1936 (field sheet 168, laboratory nos. 4611-4612):

> SE¼NW¼ Section 33: Located approximately two hundred and fifty yards west of a Forest Trail an old mine site was found. A shaft had been sunk 126 feet deep with two drifts, one 30 feet southwest at the 90-foot level while the other was at the 50-foot level and drifted 10 feet to the north. In each case small fissures were followed.
>
> At the surface barite was first detected in a two-foot vein. This mineral was followed downward leading into fissures and pockets of sphalerite and galena disseminated in the gray quartzitic sandstone of the Stanley formation of Pennsylvanian age. A good deal of calcite was found associated with the sulphides with some quartz in the brecciated zone.
>
> The slates associated with the sandstone were black, siliceous, thinly bedded deposits of the Stanley formation.
>
> The country rock had a moderate dip to the southwest 20 to 30 degrees.
>
> The shaft at the present time is practically full of water while the old machinery has been removed. The major part of the slates recovered from the mine have been used on adjoining roads.
>
> The chief metallic ore appeared to be sphalerite with some galena also being present. No shipments have ever been made. At the 126-foot level a well developed hanging wall was supposed to have been found. Mineralization however did not seem to increase with any marked degree with depth.
>
> The metallic lead was believed to have been followed several hundred yards in a northeast–southwest direction.
>
> Buffalo, New York interests had finances in this mine at one time. A Mr. John Harpending, Smithville, Oklahoma also had considerable interest.
>
> Samples of the country rock with mineralization of the sulphides together with samples of the barite were obtained for observation. Sample #168-1. Sample #168-2.

One analysis of sample 168-1 showed 54.35% Fe_2O_3, marked limonite (laboratory sample no. 4611). The other sample, 168-2, marked sphalerite and galena, was not analyzed (laboratory sample no. 4612).

The next record is that of Clifford Merritt and William E. Ham, of the Oklahoma Geological Survey, who reported on August 7, 1941 (field sheet 0430, laboratory no. 8837):

> The workings are filled in and partly grown over by vegetation. The dumps have been picked over and partly hauled away for road gravel. Honess' description [1923], thus, is more accurate than any made at the present time. Considerable barite (coarsely crystalline) was noticed in the dump but very few pieces of sphalerite are now present. The country rock is a fine grained sandstone (Stanley) cemented with finely crystalline quartz.

No analysis is given.

I collected some spot samples from the dump in July 1972, and these were analyzed by David Foster on December 4, 1975. The results are listed in Table 1 (sample no. 7).

Going Prospect

The Going prospect is in the SE¼SE¼NW¼NW¼ sec. 28, T. 1 S., R. 26 E., McCurtain County, Oklahoma (Figs. 2, 4, 19, 20). It consists of two pits about 50 ft apart, along the east side of a branch of Dry Creek, about 150 ft south of Dry Creek and 1,000 ft north of the Gibson Going house. Abner Going, the son, who was 64 years old in 1972, now lives in the house, but Abner's brother, James Going, owns the property and lives on U.S. Highway 259, half a mile north of the Beavers Bend road north of Broken Bow, McCurtain County.

The pits were first opened by Jack Frost in 1910, under the direction of John Harpending of Smithville. The north pit was about 20 ft deep, and the south pit was about 10 ft deep, oriented along a 2-ft quartz vein that strikes N. 20° E. The vein is in sandstone and phyllite of the middle Stanley Group, several hundred feet below the Battiest Chert. The regional strike of the Stanley is N. 85° W., and the dip is 55° SW. A major fault is projected along Dry Creek, striking E–W, upthrown on the south side. According to Abner Going, the north pit was about 17 ft deep in 1918, when all mining ceased.

The minerals consist of galena, sphalerite, hematite, pyrite, and calcite (Fig. 21). Honess (1923, p. 39) reported:

> Lead and zinc minerals are reported to have been procured also from the Gipson–Goen [sic] Ranch located about 2 miles west of Watson, in the NW¼ sec. 28, T. 1 S., R. 26 E., on the Stanley shale formation.

John A. Veeder, on May 18, 1936, recorded an unpublished report on sheet 171, laboratory no. 4615, of the Oklahoma Geological Survey for McCurtain County:

> Directly south of Dry Creek on property known as the Gipson–Goen [sic] Ranch a prospect hole had been sunk to a depth of seventeen feet. The shaft had been sunk in a local faulting of the underlying formations, the country rock being sandstone of the Stanley formation badly brecciated. Cracks and fissures were replaced by mineralization; sphalerite and galena associated with calcite and quartz were found to occur in small pickets and fissures. These minerals were scatteringly deposited, no concentration of any extent having taken place with seemingly no further enrichment with depth. The mineralization lead extends in a general east–northeast to west–southwest direction being traced for only a short distance each side of the prospect hole. The country rock dips to the southwest with

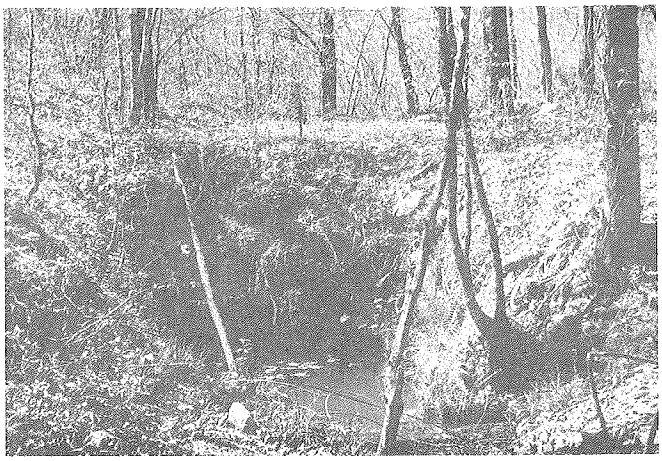


Figure 19. Going prospect, north pit, looking south along a 2-ft quartz vein that strikes N. 20° E. in Stanley phyllite and quartzite that strikes N. 85° W. and dips 55° SW. About 150 ft south of Dry Creek in SE¼SE¼NW¼NW¼ sec. 28, T. 1 S., R. 26 E., McCurtain County, Oklahoma. Pit was about 17 ft deep. April 11, 1973.

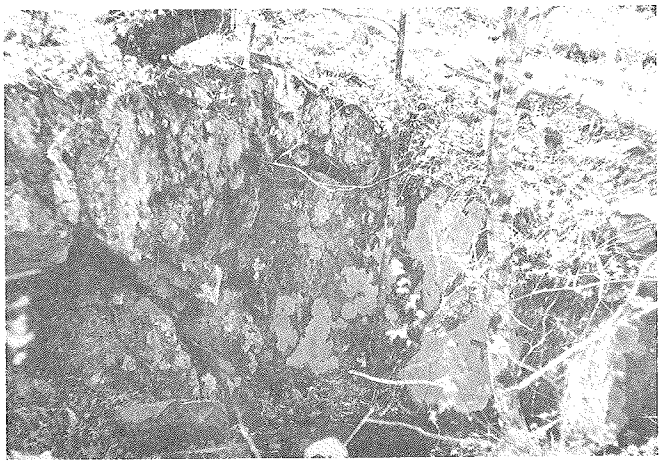


Figure 20. Going prospect, south pit, 50 ft south of north pit, looking south. Stanley quartzite dips 55° SW. Pit is 10 ft deep in SE¼SE¼NW¼NW¼ sec. 28, T. 1 S., R. 26 E., McCurtain County, Oklahoma. April 11, 1973.

Figure 21. Going prospect. Closeup view of brecciated quartzite and phyllite, with quartz, sphalerite, and galena, from tailings in SE¼SE¼NW¼NW¼ sec. 28, T. 1 S., R. 26 E., McCurtain County, Oklahoma. Main tailings are northwest of north pit. April 11, 1973.

a 40-degree angle. Samples of the country rock containing some mineralization were obtained for observation. Sample #171-1.

No chemical analysis was recorded. Clifford Merritt and William E. Ham of the Oklahoma Geological Survey visited the area on August 7, 1941, and recorded their observations on field sheet 0431, laboratory no. 8840:

> This prospect is located on the Gibson Going farm (Honess Bull. 32, incorrectly spelt it Gipson–Goen). A prospect pit 20 ft. deep has been sunk in a bluish-gray, finely crystalline sandstone (Stanley) with some associated shale–slate. The hole is now water-filled. It was worked in 1916–1918 and like most of old workings, the dumps have been picked over and give an incorrect picture of the original dumps. The dump specimens show small quartz veinlets cutting the sandstone. A little pyrite, sphalerite, and galena are present. Some small calcite veinlets were noted. Limonite stain is common.

There was no chemical analysis.

I collected samples of the minerals in 1972, and these were analyzed by David Foster on December 2, 1975. The results are shown in Table 1 (sample no. 6).

Gray Prospect

The Gray prospect is near the CSW¼SW¼NE¼ sec. 10, T. 2 S., R. 26 E., McCurtain County, Oklahoma (Figs. 2, 4, 22). The owner is Jesse Johnson, who lives about 0.75 mi west and ⅛ mi north of the main intersection of Watson, Oklahoma, about 3 mi north of the prospect. The prospect is on the south side of Little Dry Creek at the intersection of a small, westward-flowing stream, about 300 ft northwest of a local road crossing of the small stream. The prospect was named after Joe Gray, a local forest ranger who owned the property previously and who operates the general store in Watson, on the southwest side of the main intersection. Mr. Johnson purchased the property about August 3, 1950.

According to Mr. Johnson and Mr. Gray, the digging began about 1912 by John Harpending of Smithville, with backing from people in Smithville. They also began another prospect about 0.5 mi to the southwest, here named the Duncan prospect. John Harpending was a graduate mining engineer from the Colorado School of Mines. Honess (1923, p. 39) stated:

> Specimens containing galena, sphalerite, chalcopyrite, pyrite, quartz, and calcite were collected by Malcolm Oakes from a point about 2 miles south of Watson on Little Dry Creek (exact locality not known). A partial analysis of the ore from this place, made by A. C. Shead, Chemist, Oklahoma Geological Survey, shows 2 ounces of silver per ton of selected galena.

Mr. Oakes told me that the specimens came from some shallow diggings on the south side of the creek.

On May 23, 1936, Hugh Dean of the Oklahoma Geological Survey reported on field sheet 176:

> Small specimens of galena and sphalerite have been found on Little Dry Creek south of Watson. The location of the source of these minerals however has not been uncovered at the present time.

Figure 22. Gray prospect, on Little Dry Creek. View looking east at shallow bulldozed pit. Quartz vein in Stanley Group, striking N. 85° W. and dipping 40–90° N., near CSW¼ SW¼NE¼ sec. 10, T. 2 S., R. 26 E., McCurtain County, Oklahoma. April 11, 1973.

On August 7, 1941, Clifford Merritt, William E. Ham, and Joe Gray reported on Oklahoma Geological Survey sheet 0429 of McCurtain County:

> Deposit on Mr. Joe Gray's land. He is a ranger in the Forestry Dept. Date of working is not known but it was prior to 1920. Shaft 10 ft. deep. The country rock is bluish-gray quartzite (Stanley), with some interstratified shale–slate. The dump material shows some coarsely crystalline barite, a little sphalerite, and galena.

There was no chemical analysis.

A Mr. Duncan from Picher, Oklahoma, leased this area in about 1951. He dug a pit about 10 ft deep and sold the ore in Joplin, Missouri. Later a man from Texas scraped the area with a front loader and covered over most of the diggings. According to Mr. Johnson, an assay of the ore showed 16% zinc, 8% lead, 4% silver, a trace of gold, and copper unknown.

The Copperlume Corp. of Board Camp, near Mena, Arkansas, had a drilling truck on the property on April 11, 1973 (Fig. 23). J. G. Harrison was head of the corporation.

The prospect is in a quartz vein about 6 ft thick that strikes E–W along the small stream that crosses the local road, and the vein dips vertically. The host rock is phyllite and quartzite of the lower Stanley Group ~2,000 ft below the Battiest Chert, striking N. 85° W. and dipping 40–90° N. Sphalerite and galena were mined.

I collected spot samples in June and July 1972, and these were analyzed by David Foster December 4 and 16, 1975. The results are listed in Table 1 (sample nos. 8–10). Sample 8 was a vein sample, sample 9 was mostly a phyllite sample, and sample 10 was given to me by Mr. Johnson, who had collected it from the bottom of the 10-ft hole that Mr. Duncan excavated in 1951.

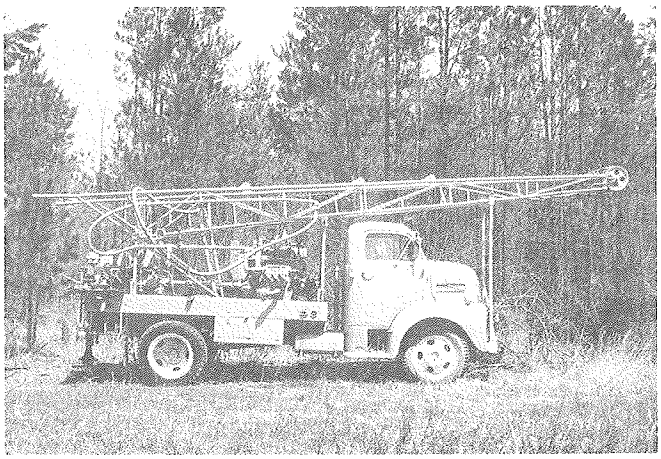


Figure 23. Drilling truck of Copperlume Corp. of Mena, Arkansas, at Gray prospect, April 11, 1973. Near CSW¼ SW¼NE¼ sec. 10, T. 2 S., R. 26 E., McCurtain County, Oklahoma.

Payne Prospect

The Payne prospect is in the NE¼NE¼NE¼NW¼SW¼ sec. 21, T. 2 S., R. 26 E., McCurtain County, Oklahoma (Figs. 2, 4, 24). It is about 150 ft north of a small creek, about 50 ft up the hill, and about 700 ft west and 300 ft north of the intersection of the main road with a north-flowing creek. It was dug by L. M. Payne of Watson, from 1928 to 1936, and was considered to be a promotional venture.

The adit was supposed to have been 90 ft deep in the side of the hill, but it appears to be about 20 ft deep north–south, by 5 ft wide, with a 10-ft entrance. It is in a 5-ft quartz vein ~100 ft below the Battiest Chert of the Stanley Group. The vein is folded and strikes E–W with dips of 45° N. and 50° S. on either side of the anticline. The north limb was mined into the hill at a 45° angle for 20–70 ft.

John A. Veeder of the Oklahoma Geological Survey reported on this prospect on May 11, 1936 (field sheet 167, laboratory no. L 7243, McCurtain County):

> Mining operations are taking place at a site approximately six miles south of Hudson known as the Payne Mine. This mine is located on the southwest slope of an east to west bearing ridge of quartzitic sandstones and shales of the Stanley formation of Pennsylvanian age. A hole has been sunk to a depth of ninety feet along a brecciated zone. The country rock at this place consists of grayish colored, dense quartzitic sandstone somewhat fractured and dark schistosic slates and shales, showing considerable pressure in places, the slates having been reduced to a shiny graphitic appearance. Frequent seams of calcite were found to be closely associated with milky quartz in the quartzitic sandstone. Small amounts of pyrite were found in small disseminated seams in the country rock. The dip of the country rock is 45 degrees to the north with a general east to west strike. Operations of the mine have been in progress at intervals for the last eight years. No shipments have been made from this mine to the present time. Owner is L. M. Payne, Watson. Samples of mine tailings have been obtained. Sample #167-1.

No analysis was given, and no mineralization was reported to total depth.

On August 7, 1941, Clifford Merritt and William E. Ham recorded their observations on field sheet 0436, laboratory no. 8841, McCurtain County:

> This working is known locally as the "Payne Mine"—worked 1934–1936. The country rock is Stanley shale–slate, sandstone, and quartzite. The workings consist of a shaft now water filled but reported to be 40 ft deep. The dump shows no metallic minerals except a few pyrite crystals and a little manganese-oxide. Small calcite stringers cut the rock. It is reported that there was considerable mining equipment and some buildings, and that a fire in 1938 or 1939 destroyed these. Why a prospect pit was sunk here and elaborate equipment installed is not clear, for no evidence of mineralization except calcite, quartz, and pyrite, can be found in the dump or nearby rock. The shaft could not be inspected as it was water filled.

No analysis was given.

I collected a spot sample from the vein in July 1972, and David Foster analyzed the sample December 4, 1975. The results are listed in Table 1 (sample no. 15).

Bellah District

The district is here named Bellah District after the famous Bellah Mine. The region is in T. 4–5 S., R. 27 E., in McCurtain County, Oklahoma, and T. 7 S., R. 32–33 W., in Sevier County, Arkansas, covering about 40 mi^2 in the southern Ouachita Mountains (Figs. 2, 6). The antimony mines are excluded from the district, being farther east and having been described by Ashley (1887), Hall (1940),

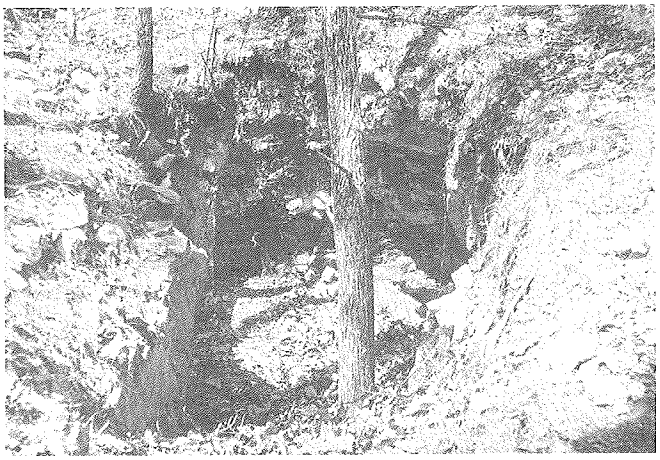


Figure 24. Payne prospect. View looking north at adit 7 ft wide, 10 ft long, and 15 ft deep. Folded quartz vein striking east–west, 50–75 ft uphill, 300 ft north of road, in NE¼NE¼ NE¼NW¼SW¼ sec. 21, T. 2 S., R. 26 E., McCurtain County, Oklahoma. April 11, 1973.

Hess (1908), Howard (1979), Jenney (1894), McElwaine (1952), Mitchell (1922), Santos (1877), Schriver (1917), Thoenen (1944), Waite (1880), and Williams (1875). All of the antimony mines were opened after the Civil War, according to Hess (1908).

The Bellah District consists of two commercial mines in Arkansas, the Bellah and Davis, and 15 prospects in Oklahoma and Arkansas, the richest of which is the Johnson prospect in Oklahoma. The mines are small, being less than half a mile long and less than 204 ft deep. Mining began in the 1820s.

The geology of the region is taken mainly from Honess (1923), Miser and Purdue (1929), and Haley and others (1976). The minerals occur in quartz veins that follow faults and shear planes of folds in the phyllites and quartzites of the middle Stanley Group (Mississippian, Chesterian Series). The structure of the area strike E–W, and the rocks dip to the north as do the axial planes of major folds. Some quartz veins are faulted. Pittenger (1974), Pittenger and Konig (1977), and Howard (1979) summarized the latest information on this area. Mitchell (1922, p. 455) discovered a 5-ft black igneous dike of ouachitite with pyrite, biotite, and augite in the Stanley on a hillslope in the SE¼ sec. 9, T. 7 S., R. 30 W., about 7 mi east of Gillham, Sevier County, Arkansas. Miser and Purdue (1929, p. 100) quoted a letter from Mitchell dated September 7, 1923, accompanied by a map, giving the exact location of the dike.

Miser (1943, 1959), Stone and Milton (1976), Konig and Stone (1977), and Howard (1979) discussed the mineralization, concluding that the deposits are mainly Pennsylvanian to Permian. The basal Cretaceous beds have vein-quartz boulders and pebbles, which rules out a Cretaceous age for the vein quartz. The main ore minerals are galena, sphalerite, and chalcopyrite, with some ankerite, calcite, siderite, pyrite, malachite, azurite, calamine, anglesite, cerussite, covellite, and tetrahedrite (with antimony and mercury), according to Pittenger and Konig (1977, p. 23). Stibnite and cinnabar are absent. Silver occurs in argentiferous galena, but gold is absent. Pittenger and Konig (1977, p. 22) reported some gold from the Davis Mine. Titanium and manganese are common. Chromium, molybdenum, nickel, and vanadium are present in small quantities. Foley (1960a,b) showed a zonal arrangement of the veins in the Bellah Mine, with galena above and sphalerite below. He mentioned that silver is associated with galena; germanium with sphalerite; gallium and selenium with both; cadmium, cobalt, nickel, tin, and arsenic with sphalerite; and traces of gold, cobalt, nickel, uranium, silver, arsenic, tin, rubidium, strontium, titanium, zirconium, and yttrium with chalcopyrite. Phillips (1901a) mentioned that galena was separated by jigging. The iron was separated by gently roasting the zinc concentrate and running this through a magnetic separator. This increased the zinc concentrate from 48% to 58% and decreased iron from 6.71% to 1.65%. (There was a penalty for each percentage point of zinc below 60% and for each percentage point of iron above 1%.)

All analyses in the present investigation were completed by David Foster, using methods of emission spectroscopy and atomic absorption.

The mines and prospects are listed alphabetically.

Bellah Mine

The Bellah mine is in the SE¼NW¼NW¼SW¼ sec. 27, T. 7 S., R. 32 W., Sevier County, Arkansas, about a quarter of a mile west of the Rolling Fork River, on the flood plain about 20 ft above the river (Fig. 25). The mine consisted of a main shaft 165 ft deep, with three east drifts at depths of 44, 115, and 165 ft, and another shaft 115 ft deep and an air shaft to the east 44 ft deep. A few shallow pits extended eastward for 1,000 ft. Foley (1960a, p. 1552) traced the vein 350 ft to the east, and cut the vein 158 ft deep. Local residents stated that the underground diggings also extended westward about 1,000 ft, almost below the main bottom road. The mine was opened between 1820 and 1830 by John S. Bellah and his brother, Richard W. Bellah. The mine closed when John Bellah died in 1856.

The ore consisted of galena, sphalerite, and chalcopyrite in a 3- to 8-ft zone of quartz veins in phyllite of the middle Stanley Group (Fig. 26). A mill was erected; the milled ore was 21% zinc sulfide, and the sold ore was about 60% or more zinc. The vein strikes N. 80° E. and dips about 70° N., with local variations in strike up to N. 80° W. at the surface. This trend continues northeastward for 5 mi and includes eight more mines that contain stibnite. Approximately 120,000 short tons of rock and ore was removed, of which about 6,000 tons was probably concentrated ore. Hall (1940, p. 83) stated that the ore was shipped to Joplin, Missouri, after crushing and concentration on jigs.

I collected samples from the dump in June 1972, and these were analyzed on June 30, 1975. The results are listed in Table 1 (samples 20 and 21).

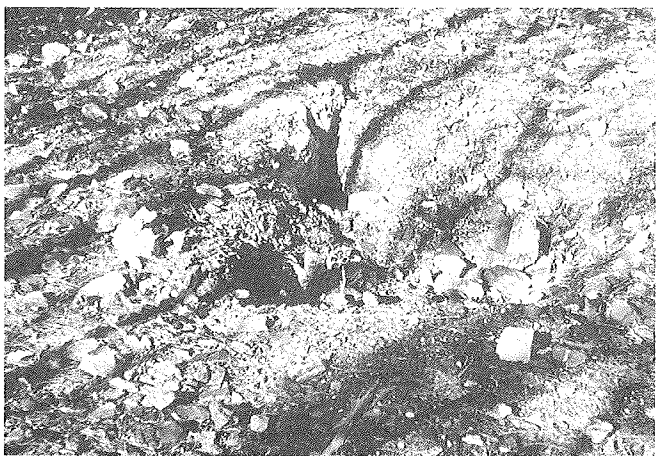


Figure 25. Bellah Mine, main shaft, bulldozed closed, looking east. Mine is now under water in SE¼NW¼NW¼SW¼ sec. 27, T. 7 S., R. 32 W., Sevier County, Arkansas. Vein in Stanley rocks trended N. 80° E. and dipped N. 70°. April 10, 1973.

Pittenger (1974, p. 38) and Pittenger and Konig (1977, p. 23) listed cadmium, germanium, mercury, and antimony, along with siderite and tetrahedrite (Table 2). Foley (1960a,b), as previously mentioned, noted gallium, selenium, cobalt, tin, arsenic, gold, uranium, rubidium, strontium, zirconium, and yttrium in the Bellah deposits.

The earliest written record of the mine is that of Owen and others (1860, p. 110–112):

> The Bellah mine is situated in the northern part of the county, on Section 21 or 22, Township 7 south, Range 32 west, four miles east of the western boundary of Arkansas.
>
> In a direction very nearly east and west, where the slate in a fissured condition shows signs of disruption, metallic ores can be traced imbedded in crevices of the same character, in almost every respect, with those found at the Kellogg mine, in Pulaski: namely argentiferous galena, sulphurets and carbonates of copper, carbonates and sulphurets of zinc, red and brown oxides of iron, and iron pyrites.
>
> Some years since, attempts were made to explore this vein. A ditch was sunk six to ten feet deep, and nearly one hundred yards in length. Some six shafts of pits were dug, which are now, however, abandoned and filled with water. The debris about these old diggings prove that the vein must have been rich in these different ores, from the number of specimens strewed along the bank of the ditch and about the mouths of the shafts.

TABLE 2.—Chemical Analyses of Selected Materials from the Bellah Mine

Element	Grab sample	Galena	Chalcopyrite	Siderite	Sphalerite
Ag	—	0.021	0.003	0.005	0.007
Cd	—	0.001	nil	0.001	0.130
Cu	6.80	0.700	28.200	0.158	0.068
Ge	—	—	nil	nil	0.002
Hg	0.05	0.070	1.120	0.070	0.100
Pb	0.38	44.000	0.089	0.030	1.080
Sb	0.03	0.121	0.054	0.044	0.051
Zn	36.30	4.290	0.017	0.105	57.400

NOTE: After Pittenger and Konig, 1979, p. 23; results expressed in percent.

Figure 26. Bellah Mine samples: sphalerite, galena, chalcopyrite, and malachite in quartz veins, from tailings, in SE¼NW¼ NW¼SW¼ sec. 27, T. 7 S., R. 32 W., Sevier County, Arkansas. April 10, 1973.

There is every reason to believe that this is the extension of the Kellog vein of Pulaski County which, appearing at intervals, but less marked in its characters, runs nearly across the middle and western part of the State, in a course more or less from northeast to southwest, and gives strong confirmation to the opinion formerly expressed, that the course of this vein demands a detailed geological survey; both to determine the precise course and ramifications of the vein, and to ascertain its promise of productiveness.

The argentiferous galena from this mine has been analyzed and cupelled, with the following results: The average yield of lead, 73 per cent. This lead cupelled, yielded in proportion 52½ ounces of silver to the ton of lead.

The qualities of argentiferous galena are very various in this vein, and no doubt, there are portions of the ore, that would yield a much higher percentage of silver.

As there was no one at the mine, or in the neighborhood, who could give me any reliable information regarding the work that had been done in former times on this vein, I addressed a letter to Richard W. Bellah, now residing in Texas, one of the principal owners, and the person who had conducted most of the work, in order to obtain some statistics.

He writes, that there were three principal shafts sunk, two of which were thirty feet deep, the other seventeen feet. The ore he considered to be in a continuous vein, increasing in thickness as far down as he went. Several other shafts were sunk from six to twelve feet deep, and he reports the ore to be continuous also in them. Mr. Bellah could not give the exact amount of ore raised; but he is of opinion that it was five tons, or perhaps more.

He states, also, that there were not as much of the green and blue carbonates and sulphurets of copper, after going sixteen feet, as appeared near the surface of the ground. He sent a portion of the ore to Liverpool, England, to be tested, and received a statement in return to the effect that the ore yielded 73 per cent of lead and 148 ounces of silver to the ton.

Although Mr. Bellah had to abandon the mine, and move to Texas, he seems to put a high value upon the property, as he says: "I am not willing to lease the mines; but I will sell for a reasonable price, provided my brother and sister will sell at the same time, which I have no doubt they will. I have put a price upon the mines, and value it altogether at $10,000.

"There are 400 acres of land in our claim, the title of which is perfectly good."

Comstock (1888, p. 146) mentioned:

The Blue Mountain axis was observed only in sections 9, 10, 3 and 2, 7 S., 32 W., in Sevier county, but from all that could be learned, it seems certain that it continues southwestward to the boundary line of Indian Territory at least. The Bellah mine is on or near its course. This mine was shut down and not in shape for investigation at the time of the writer's visit, and was therefore not examined.

Bain and others (1901, p. 132–133, 202) mentioned:

In this report fractures, when accompanied by notable faulting, will be referred to as fissures and the ores developed along such fractures will be called fissure veins. . . .

True fissure veins are the rarest type occurring in the region. The veins found in southwestern Arkansas are mainly of this type. The Bellah mine of the North American Ore and Metal Company may be taken as typical. This mine is located in Sevier County, Ark. (secs. 27 and 28, T. 7 S., R. 32 W.), about 6½ miles southwest of Gillham, which is on the Kansas City, Pittsburg and Gulf Railway. The mine was worked during the civil war by the Confederate government for lead, and the slag and furnace remains indicate that work was carried on for some time. The country rock is a black shale, presumably of Lower Carboniferous age. The vein is well defined and cuts across the beds with a strike of E. 8° N. At the surface it is practically perpendicular, but in depth it dips toward the north, the dip at 145 feet being 80°. In the vicinity of the mine the vein has been developed by test pits for a distance of about a thousand feet, and a vein, supposedly the same, has been traced several miles. The vein has been developed to a depth of 160 feet with drifts both east and west at 50 and 115 feet. The old workings from which the lead was taken were above the 50-foot level. At present at the 115-foot level and below, blende is the most important ore. With it are minor amounts of galena and chalcopyrite. The galena was abundant in the upper workings, which were also said to carry more chalcopyrite. The vein is 3 to 8 feet wide and has well-defined walls showing both vertical and horizontal slickensides. It carries abundant sharp-angled pieces of the country rock and a large amount of quartz, which occurs in part in small crystals lining the vugs and druses in the vein and in part in streaks and bands running through the vein. It is also comby and is arranged with the ore in ribbon structure, though there is no uniform sequence for the vein as a whole. The wall rock on either side shows evidence of shearing in thin partings filled with quartz. In all these particulars the Bellah is a typical fissure vein. The mines in the same vicinity, the Davis, the mines at Antimony City, and others are located on veins of the same general type. . . .

Southwestern Arkansas is outside of the Ozark region, and was visited only incidentally. The Bellah mine, already described, is typical. The country rock consists of a series of folded and faulted shales and sandstones. The veins are fissure veins and the association of the ores is very different from that in the Ozark region. The deposits show interesting evidences of secondary enrichment and many phenomena similar to those relating to the ores of the other districts. Their general character is, however, very different and they form a wholly separate class of deposits, which will not be here discussed.

In February 7, 1900, an interesting column appeared in *The Gillham Miner*:

THE BELLAH MINE.—Representative of Miner Finds Everything Flourishing—At the Bellah—Short Sketch of Things of Interest We Observed Last Monday—

In company with Mr. and Mrs. E. L. Williams, and Mr. and Mrs. Joseph Meredith, a representative of the "Miner" visited the Bellah mines Monday. The drive was very pleasant. We were surprised to see the country so well settled, but imagine our surprise after we

had crossed Rolling Fork river a few hundred yards to find in the woods a new town almost completed. Judge Hughes, with a large force of men, were pushing the work on the buildings. He is a fine mechanic. On inquiring we ascertained that he has under contract, and almost completed, the following buildings. One 44 × 24 feet boarding house, with four rooms and hall; one 20 × 32 feet commissary; one business office 16 × 16 feet; assay office 16 × 16 feet; two residences 14 × 22 and one residence 16 × 24 feet; one barn 30 × 32 feet, with loft, grainery and cribs, and we feel safe in saying it is the best barn in the country; a 40 × 60 feet boiler house; an air compressor and hoister room; one timber house 20 × 30 feet, and one blacksmith and carpenter shop 20 × 30 feet. Everything is being built in a business-like manner.

On arriving at the mines, situated about 800 feet from the new village, the manager in charge Joseph Meredith showed us over the works. In the machinery line we noticed a 70-horse power boiler, a 75-horse power Ingersoll Sargeant air compressor, a Ledgerwood double cylinder steam hoist of sufficient power to sink 300 feet, one Cameron vertical sinking pump, 3 inch suction and 4 inch discharge, which will handle water from the shaft for at least 500 feet, also a 30-horse power Atlas engine. Mr. Meredith informed us that they would put in a saw mill at once as it was a very hard matter to get what lumber they wanted.

That the North American Ore & Metal Co. have abundant faith in the Bellah property is evident in every direction you look. The land is being cleared and hundreds of cords of wood are already cut and corded up.

. . .The "Miner" was taken down the shaft by Supt. [Joseph] Meredith and into the level running off on the big vein, where all was activity, men being at work sinking shaft and extending the level east along the big vein. Bellah vein is a true fissure averaging over 4 feet of zinc and lead ore, and in places shows over 6 feet wide. The ore in the Bellah compares already very favorably with the best zinc and lead ores of the Missouri and Kansas districts, and will doubtless increase in value and size as the new shaft is sunk to a greater depth. With two properties like the Bellah and the Davis mines now being systematically prospected and developed by strong companies, the future of this district is assured by such evidence of faith as is shown by this company. The hardy and industrious prospector will soon cover the district, and with drill, pick and powder discover other valuable ledges or ore veins which investors will purchase and develop into mines.

With the mining industry firmly established Gillham and Sevier county are bound to move to the front.

Miser and Purdue (1929, p. 166–167) summarized as follows:

Two mines, the Bellah and Davis, have been worked from time to time in the De Queen quadrangle and have produced small quantities of lead and zinc ores, and a few prospects in this quadrangle have been opened in search of these ores. The ore deposits occupy fissure veins associated with quartz in steeply dipping sandstone and shale of Carboniferous age, and there is evidence of faulting along some of the veins. The ore minerals are sphalerite and galena, and the associated minerals besides quartz are chalcopyrite, pyrite, siderite, calcite, azurite, and malachite, the last two occurring only near the surface. The occurrence of the ores in faulted fissure veins combined with their nearness to the antimony deposits near Gillham, which in origin are probably related to igneous rocks, suggests that the lead and zinc ores were also similarly related.

Some of the lead and zinc deposits in the De Queen quadrangle can probably be worked spasmodically in the future, just as they have been in the past, but the known deposits are comparatively small and hence are not capable of a large production of ores.

The Bellah mine is in secs. 27 and 28, T. 7 S., R. 32 W., about 6 miles southwest of Gillham, in the northwest corner of Sevier County. It was idle and was filled with water at the time of the field examination by the authors, and the description of it given herewith is abstracted largely from the report by Bain [1901], who visited the mine many years ago, and from field notes by D. F. Hewett, who entered the mine in 1912.

The mine was worked during the Civil War by the Confederate government for lead, but since then it has been operated at times as a zinc mine. The slag and furnace remains indicate that work at that early date was carried on for some time. The owners of the mine in 1912 were Tyler & Hippach, and the lessees were Sober, Williford & Lynn, who reopened the mine and operated it for several months before the fall of 1912.

The workings consist of a shaft 165 feet deep with drifts to the east at depths of 44, 115, and 165 feet; an air shaft 44 feet deep; and a third shaft 115 feet deep. When the mine is idle, water stands at the 115-foot level. The shafts and a few pits have been made at places along the length of the ore body for a distance of about 1,000 feet.

The country rock is the Stanley shale, and the part of the formation occurring in the vicinity of the mine is a bluish-black clay shale. The ore body occurs in a zone with a maximum width of 8 feet, in which there are irregular fractures filled with quartz. The zone strikes N. 80° E. and is practically vertical at the surface, but at moderate depth it dips 60°–70° N. The hanging wall of the zone is well defined, as it is marked by a clay selvage. It has striations with a dip of 15° E., showing that there has been faulting with both a vertical and a horizontal component. White massive quartz, which constitutes much of the zone, carries abundant sharp-angled pieces of the country rock, but some of the quartz occurs in small crystals lining the vugs and druses in the vein and in streaks and bands running through the zone. It is arranged with the ore in ribbon structure, though there is no uniform sequence for the deposits as a whole. The metallic minerals that are associated with the quartz are sphalerite, galena, chalcopyrite, and pyrite. Galena was the most abundant ore above the 44-foot level, but at present at and below the 115-foot level sphalerite of a rosin-yellow color is the most abundant. With it are minor quantities of galena and chalcopyrite, and negligible quantities of pyrite. Some of the chalcopyrite has yielded a little azurite and malachite, especially near the surface. Associated with the quartz is a small quantity of siderite. The exact order of deposition of all the minerals is not known, but to judge from material on the dump the sphalerite, chalcopyrite, galena, and pyrite followed at least most of the quartz and siderite.

The ore-bearing zone has been partly stoped east of the 165-foot shaft above the 44-foot level. It has also been stoped for a distance of 60 to 80 feet from this shaft above the 115-foot level, though no connection has been made with the 44-foot level. The workings on the 115-foot level extend from this shaft a distance of 200 feet.

The ore that has been milled is said to have yielded 21 per cent of zinc sulphide, and the ore sold is said to have contained 60 per cent or more of metallic zinc.

Williams (1959, p. 52) stated:

In the mineral belt of west-central Arkansas a few zinc and lead mines were worked at Petty, six miles west of Gillham, Sevier County, in the early 1860's by the Confederate States Government. Between 1,000 and 1,500 tons were mined and three lead furnaces were in operation. In 1899 the North American Ore and Metal Company reopened, and for several years operated the same mines in Sevier County. During the first two years 1,140 tons of ore were removed. The district has been practically inactive ever since. [Petty was just northeast of Bellah about half a mile.]

Harold Mabry (1966, p. 22, 42–43, 57–58, 80, 89), retired editor of the *De Queen Bee*, compiled many local stories, including those about the Bellah District. He mentioned that there were 1,113 recorded mining claims in Sevier County between 1891 and 1927, mostly in the antimony region. His story on the Bellah Mine (p. 42–43) is as follows:

John Bellah also found time sometime before the Civil War to open the Bellah Mine, near Gillham, Ark. in [the] slate and it was worked at intervals up until 1914.

During one of these intervals, in 1900, the American Ore and Metal Co., completed the work of putting in a concentrating mill and started to operate it on Nov. 14. The mill had a capacity of 100 tons daily. At that time, they had 4,000 tons of ore on the ground.

According to assays and mill tests the mine was 19.1 per cent lead and zinc. That is to say, out of every 100 tons of rock and ore brought up, 19 and one-tenth was lead and zinc which also carried $3.36 worth of silver as well as a trace of gold.

They were working three levels, at depths of 50, 115 and 165 feet.

A *De Queen Bee* reporter (Mabry, 1966, p. 42–43 wrote:

The formation is a true fissure vein, running through a country rock of slate. The vein matter carrying the ore is white quartz.

About 250 feet of levels have been run, and the shaft is now 168 feet in depth. The vein at outcrop is about 2½ feet thick, increasing in width from six to 12 feet deep in depth. All levels have been continuous in ore, likewise the shaft depth to 125 feet where the vein dips north at an angle of about 60 degrees.

The company is now employing about 55 men in various working depths, the men living in the vicinity of the mine.

The company operates a sawmill for its own uses, the lumber costing about $4.00 per thousand feet for construction purposes and about $3.00 for mine timbers. The formation of the mine is such that it does not require extensive mine timbering.

The development work of this mine has consumed over a year's time.

Realizing the present isolation from machinery and repair shops, nothing but the best, heaviest and simplest machinery has been purchased.

Anticipating an increased production as development work continues, the company has installed steam and engine power larger than is necessary for present requirements but from all appearances it will be needed before many months.

The company owns in fee over 1½ miles of vein and lode in which they are now working.

The mine furnishes no more water than will comfortably supply the concentrating mill.

Timber is abundant for fuel and lumber.

The reporter said the distance to Bellah mine from De Queen, Ark., as the bird flies is 7 miles, for a man on horseback, 9 or 10 miles, but in a buggy, a good 12 miles. At this time, L. L. Petty (Mabry, 1966, p. 42–43) stated:

Work at Davis mine (west of Gillham, Ark.) is progressing rapidly and I have a mine of mine own that promises good results later on and which is expected to yield chiefly copper, with some silver.

A bulletin of the U.S. Geological Survey published in the teens states that the confederate forces mined Bellah for lead during the Civil War.

And old mining men say it's still there.

Black Horse Prospect

The Black Horse prospect is in the NW¼NW¼SE¼ sec. 22, T. 7 S., R. 32 W., Sevier County, Arkansas (Figs. 2, 6). Hall (1940, p. 79) first located this prospect, and Stroud and others (1969, p. 374) first published the location. I did not visit the prospect, and I am not certain of the exact location. The only description is that of Hall (1940, p. 79–80):

Very little is known of this mine. No mention is made of it anywhere in the literature and even the natives in the vicinity had only a hazy recollection of it. The old shaft, now badly caved and overgrown with brush and weeds, is located in the NW¼SE¼ sec. 22, T. 7 S., R. 32 W. It was filled with debris and water to within 20 feet of the surface. Slumping and weathering obscured the rock in the hole. Just a few paces northeast of the shaft is a small outcrop of gray quartzitic sandstone, striking, N. 10° W., and dipping S.W. 5°. It was cut by two sets of practically vertical joints, one striking N. 30° W., the other N. 70° E.

The dump material contains some interesting specimens of vein breccia. This contains many particles of Stanley shale, usually with rather flattened, ovoid shapes. None of these is greater than one inch in maximum dimension; each is coated with a thin sheath of ankerite, and enclosed in a crystalline quartz matrix. The ankerite has weathered to a brown color on the outer surfaces in most specimens, and in a few it appears to have oxidized completely to limonite. Locally, the ankerite forms the entire matrix. This is believed to be a fault breccia, in which the mineralizing solutions penetrated the fault zone, surrounded the shale particles, and progressively separated them as the vein minerals crystallized. The only sulfides seen in dump

specimens were pyrite, occurring in a few small blebs, and chalcopyrite, in tiny needles between crystals and on fracture surfaces, obviously later than the quartz and ankerite. Nothing is known of production. The mine is believed to have been opened in the early 1890's, when the Bellah mine was in operation. Probably the ores sought here were not those of antimony, but rather those of copper, lead, and zinc.

Branson Prospect

The Branson prospect is in the NE¼SE¼SE¼NW¼ SE¼ sec. 4, T. 7 S., R. 32 W., Sevier County, Arkansas. It is a 30-ft adit at the crest of an anticline, on the west bank of Rolling Fork River, about 15 ft above the river (Figs. 2, 6, 27). The 2-ft quartz vein in quartzites and phyllites of the middle Stanley Group strikes N. 80° W. and dips 45° N. The prospect was dug by Ben Branson and his father in 1912. Ben Branson and his son, Billy, live about 2.5 mi southeast of the prospect, and they know most of the local history of the mines in the area, being the owners of the Davis Mine.

I collected some samples in June 1972, which were analyzed by David Foster on June 30, 1975. The results are recorded in Table 1 (sample 24).

This prospect is on strike with the Hollingsworth prospect.

Brewer Prospect

The Brewer prospect is in the SW¼SW¼NW¼NW¼ sec. 22, T. 7 S., R. 32 W., Sevier County, Arkansas (Figs. 2, 6). According to Dee Brewer, who lives a short distance south of the prospect, George Brewer dug two pits here about 1917, each about 10 ft square and 10 ft deep, on the south side of the ravine. The host rock is sandstone and phyllite of the middle Stanley Group, with small quartz veins that strike N. 80° E. and dip 65° N. No mineralization was noted.

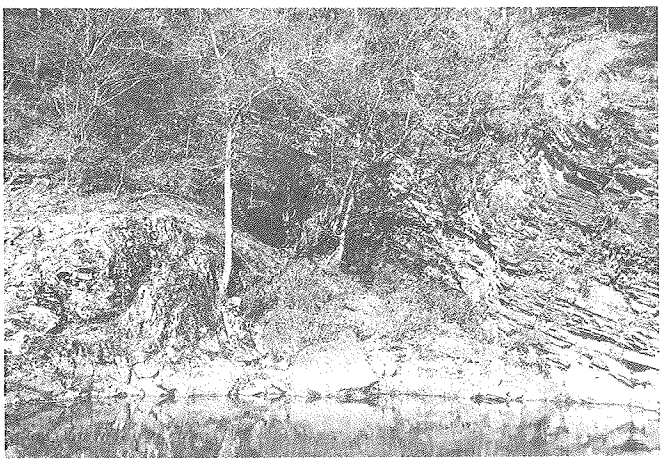


Figure 27. Branson prospect. View looking west on west side of Rolling Fork River, in faulted anticline in Stanley quartzites and phyllites, with dip 45° N. A 30-ft adit in NE¼SE¼SE¼NW¼SE¼ sec. 4, T. 7 S., R. 32 W., Sevier County, Arkansas. April 11, 1973.

Hall (1940, p. 47) stated:

> In assays of a mineral from a prospect on the property of G. W. Brewer, Jr., on Rolling Fork, near the center of sec. 22, T. 7 S., R. 32 W., platinum was reported, occurring with the following: lead, silver, copper, gold, iridium, tungsten, rubidium, molybdenum, bismuth, tellurium, cerium, tin, chromium, strontium, and ruthenium. Microscopic examination shows the "ore" to consist of tiny veinlets of a mica or possibly vermiculite in shale. [This locality is closer to the Black Horse prospect than to the Brewer prospect.]

Copper Prospect

This is an unnamed prospect that was termed Copper prospect by Miser and Purdue (1929, map); it is on a high hill in the SE¼NW¼NW¼ sec. 9, T. 7 S., R. 32 W., Sevier County, Arkansas (Figs. 2, 6). I was unable to locate this prospect, which is easily accessible by a logging road from the north. I walked over most of this part of the section, which has been cleared, and I presume that the prospect has been filled in.

Copper King Prospect

The Copper King prospect is in the SW¼NW¼NE¼ SW¼ sec. 8, T. 7 S., R. 32 W., Sevier County, Arkansas, on the northwest side of Robinson Creek (Figs. 2, 6). It is on an incline in a quartz vein in phyllite of the middle Stanley Group, striking N. 80° W. and dipping 45° N. The incline is 150 ft long (east–west) by 5 ft wide by 15 ft deep, the bottom of the inclined trench being about 15 ft above creek level on the east end, and the top about 75 ft above creek level on the west end. Another small pit was found on the opposite bank, about 750 ft southeast of the Copper King and about 50 ft above the creek.

Miser and Purdue (1929, p. 168–169) reported on this prospect as follows:

> The Copper King prospect is in the W½ sec. 8, T. 7 S., R. 32 W., 2 miles west of the Davis mine and 6½ miles west of Gillham. Work was done at this locality many years ago, and so far as the authors are aware no ore from the mine was ever sold.
>
> The openings include an east–west cut on the right bank of Robinson Creek, having a length of 36 feet and a face of 12 to 15 feet, an inclined shaft 12 to 14 feet deep at the west end of the cut, two shallow pits east of the cut, and a short north–south cut and an incline which are 150 feet west of the east–west cut, on the hill slope 75 feet above the creek.
>
> The rocks penetrated by the openings are a hard gray sandstone that has a dip of 45° or more toward the north and strikes N. 80° W. Some beds of the sandstone have been much fractured and contain many quartz veins, most of which are less than 1 inch wide, though a quartz vein 3 feet wide was seen at one place. Quartz is the only mineral that was seen in place, but a few small specimens of it containing calcite, chalcopyrite, azurite, and malachite were found on the dump.

In June 1972 I collected a quartz sample from the middle of the deposit, and the sample was analyzed by David Foster on June 10, 1975. The results are given in Table 1 (sample 25).

Davis Mine

The Davis or Lost Boy Mine is near the CSE¼NW¼ NW¼ sec. 10, T. 7 S., R. 32 W., Sevier County, Arkansas, on the north side of Price Creek (Figs. 2, 6, 28–33). It is owned by Ben Branson and his son, Billy Branson, who showed me the mine; they live about 2 mi east of the mine.

The galena was first discovered by a Choctaw Indian boy who was lost for several days and who wandered through the area in about 1830. Many years later he returned with Julius Folsom, a Choctaw chief, who opened the mine in 1842. The early name was the Lost Boy Mine.

The best description of the mine is that of Miser and Purdue (1929, p. 167–168):

> The Davis mine is in the NW¼ sec. 10, T. 7 S., R. 32 W., 4 miles west-southwest of Mineral, on the Kansas City Southern Railway, in the northwest corner of Sevier County. It is reported that Julius Folsom, a Choctaw chief, opened the mine in 1842, and that a zinc smelter was erected at the mine in 1875 or 1876. Sam Davis worked the mine in the eighties and sold it about 1900 to the Southern Zinc Copper Mining Co. This company, which operated the mine for six years ending in 1906, produced both lead and zinc ores, which were hauled to Mineral for shipment. During the period of greatest production the shipments averaged one carload of ore every week. In 1911 and 1912 the mine was worked by Karl Shuey, who shipped 15 or 16 carloads of ore, half of it sphalerite and the other half galena. The mine was next worked by A. V. Oliver, beginning in March, 1916, and then by the Boston & Arkansas Mining Co., of Okmulgee, Okla.
>
> The workings at the time of visit (1916) consisted of four shafts from which several drifts had been run. The deepest shaft is said to have been 204 feet deep.
>
> The rocks at this locality are black shale and hard gray sandstone, which are a part of the formation known as the Stanley shale. They dip 50° or more to the north, and they have been cut by two or more faults, as is indicated by the presence of smooth slickensided planes with steep dips. The fault farthest south dips about 60° N. and strikes N. 85° E. The shale and sandstone above this fault are much fractured and crumpled and contain quartz veins through a zone as much as 40 feet wide.
>
> The quartz veins in this zone, especially those adjacent to the foot-wall, carry sphalerite, galena, chalcopyrite, and calcite, the most abundant named first. In addition there are small quantities of azurite and malachite near the surface, and small quantities of calamine were reported to be present at some places. The sphalerite, galena, and chalcopyrite are more or less intermixed; they occur as single crystals and aggregates of crystals disseminated through the quartz veins and as solid veins, some of which cut through quartzite without quartz. Assays of specimens of these minerals that have been made by the Arkansas Geological Survey showed the presence of a trace of gold and from 17.5 to 31 ounces of silver to the ton [Comstock, 1888, p. 233, 252].
>
> The working at the time of visit appeared to show that the deposit has a length of at least 300 feet, a width of as much as 30 to 40 feet, and a depth of 204 feet, which is said to be the depth of the deepest shaft.

Figure 28. Davis Mine, main shaft, looking east and obliquely downward. Shaft is about 204 ft deep in 40-ft vein that strikes east–west and dips about 60° N., near CSE¼ NW¼NW¼ sec. 10, T. 7 S., R. 32 W., Sevier County, Arkansas. April 11, 1973.

Figure 29. Davis Mine, secondary shaft north of main shaft, looking east and obliquely downward. Stanley beds dip steeply northward, near CSE¼NW¼NW¼ sec. 10, T. 7 S., R. 32 W., Sevier County, Arkansas. April 11, 1973.

According to Mr. Branson, the vein can be traced for half a mile or more eastward, and a small train that operated underground is still in the mine. The diggings also extended westward. The ore was segregated along vertical veins such that one mineral could be selectively mined without mixture with another mineral. Mabry (1966, p. 41) stated that work stopped at this mine be-

Figure 30. Davis Mine, looking east at old foundations south of main shaft, near CSE¼NW¼NW¼ sec. 10, T. 7 S., R. 32 W., Sevier County, Arkansas. April 11, 1973.

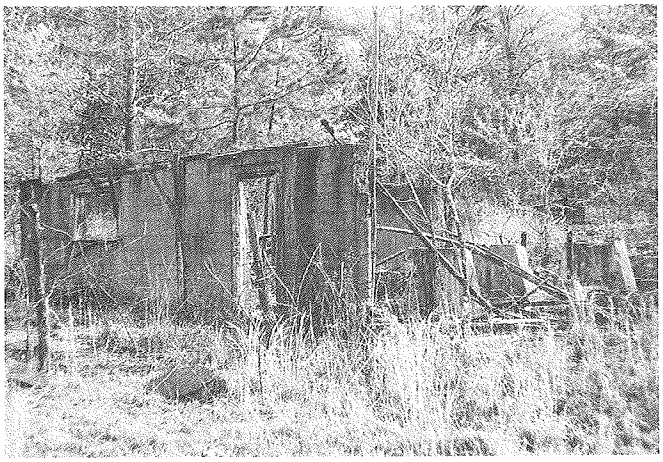


Figure 31. Davis Mine, machinery building north of main shaft, looking northeast, near CSE¼NW¼NW¼ sec. 10, T. 7 S., R. 32 W., Sevier County, Arkansas. April 11, 1973.

cause pumps were inadequate to keep water from the shafts, and that the mine is about 100 yd from the river.

The earliest account of the Davis mine is that of Comstock (1888, p. 146–147, 233, 252):

> The Davis Mine.—In section 10, 7 S., 32 W., upon a branch of the Rolling fork, some prospecting has been done directly in the Blue Mountain axis. The stream here follows very nearly the fault line, exposing the black shales upon the eastern side, and high vertical walls of the grits and sandstones upon the western side. A shaft, with a small pumping and hoisting outfit, was being worked in August, 1887, in an attempt to strike an ore pocket that had been previously struck in a tunnel less than fifty feet lower. The strike of the deposit being along the general course of the stream, some explorations up and down the narrow valley had also exposed patches of ore. Although very little work has been done and the quantity mined has not been large, the product has been of good quality. The minerals are galena, chalcopyrite, sphalerite, and some tetrahedrite and allied forms. Assays of the specimens gathered here would be of but little use as guides to the value of the mines, for there is very little ore in sight. The conditions are in most respects the same as were reported at the Montezuma mine in northern Montgomery county, but in Sevier county the external evidences of hot springs are absent. It is probable that this area was covered by the sea while the thermal springs were active in the unsubmerged areas northeastward along the same uplift. The Blue Mountain belt certainly deserves thorough investigation. The time given to it was wholly insufficient to enable a detailed report to be prepared thereon, but the ores are certainly rich in silver.
>
> Very probably rich ore-pockets, possibly continuous veins, will be found in deeper workings, but these cannot be defined except by actual exploration. The methods of mining heretofore adopted will not prove remunerative, for they have caused the workings to crosscut the ore deposits instead of following them in depth.

The area around the Davis Mine was termed the Silver Hill District. An assay of selected specimens by Comstock (1888, p. 252) showed 23% lead, 7% copper, 18% zinc, and silver 17.5 oz/ton. Allen (1910), Hall (1940), and Stroud and others (1969) also described the Davis Mine. The mineralized vein strikes N. 82° E. and dips 85° NW., according to Allen (1910). Hall (1940) said there was a drift at the 100-ft level that followed the vein 400 ft eastward and was stoped nearly to the surface. Another drift at the same level continued 60 ft westward.

I estimate that at least 320,000 short tons of ore and rock was mined, of which 16,000 short tons was crushed concentrate. Hall (1940, p. 83) had these comments:

> The waste pile is a large one, some 150 yards long, and 40 to 60 feet high in places. . . .The tailings from the mill dump was being cut away and washed by the Pio-

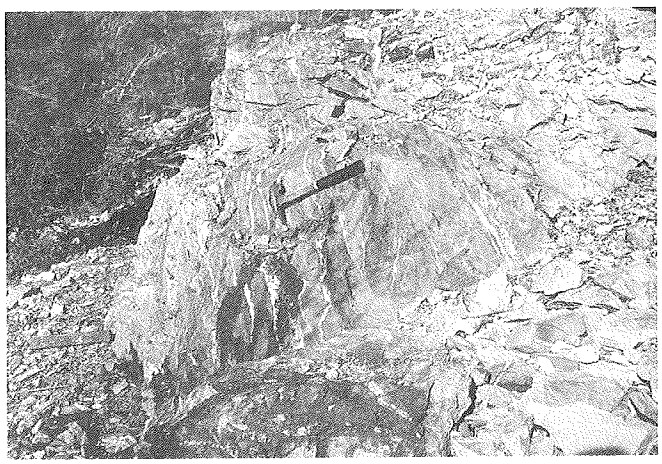


Figure 32. Davis Mine. Stanley quartzite and phyllite with quartz veins, looking west near main-shaft entrance, with dip steeply north, near CSE¼NW¼NW¼ sec. 10, T. 7 S., R. 32 W., Sevier County, Arkansas. April 11, 1973.

Figure 33. Davis Mine. Samples of sphalerite in quartz veins in Stanley quartzite and phyllite, from tailings, near CSE¼ NW¼NW¼ sec. 10, T. 7 S., R. 32 W., Sevier County, Arkansas. April 11, 1973.

> neer Construction Company of Malvern, Arkansas, to be used as road-metal in the construction of the section of U.S. Highway 71 between DeQueen and Mena. . . . The ore was shipped to Joplin for treatment.

In June 1972, I collected some spot samples, which were analyzed by David Foster on June 30, 1975. The results are tabulated in Table 1 (samples 22 and 23).

Pittenger and Konig (1977, p. 22) verified a trace of gold and minor amounts of antimony. Tetrahedrite $Cu_3(Sb,As)S_3$ has been reported. Foley (1960b, p. 1553) listed 0.062% selenium from galena and a trace of selenium from sphalerite from the Davis Mine.

Givens Prospects

The Givens no. 1 prospect is in the NW¼SE¼NW¼ NW¼ sec. 16, T. 5 S., R. 27 E., McCurtain County, Oklahoma (Figs. 2, 6). It is on the southeast side of a branch of Cedar Creek, about 100 ft from the branch, low in the valley wall. It is a trench 20 ft long (trending northwest) by 5 ft wide by 5 ft deep. The deposit consists of pyrite and hematite with quartz and calcite veins in a 2-ft sandstone of the middle Stanley Group, striking N. 80° E. and dipping 35° N. Arthur Givens dug the trench in 1917, with assistance from a Mr. Martinbough of Buffalo, New York, both of whom worked for John Harpending of Smithville, McCurtain County, Oklahoma. I collected some spot samples from the vein in June 1972, and the rock was analyzed by David Foster on June 30, 1975. The results are given in Table 1 (sample 19).

The Givens no. 2 prospect is in the SW¼NE¼SE¼NE¼ of sec. 17, T. 5 S., R. 27 E., about 150 ft southeast of Cedar Creek, along the valley wall. It is a shallow pit in a quartz vein that strikes E–W in the middle Stanley Group (Figs. 2, 6). Some pyrite and hematite were found, but the rock was not analyzed. The prospect was dug by Arthur Givens about 1917 or later.

Higgins Prospect

The Higgins prospect is in the NE¼NW¼NW¼NE¼ sec. 36, T. 7 S., R. 33 W., Sevier County, Arkansas (Figs. 2, 6). It is about 1,000 ft north–northeast of Grover Higgins's house, on the southwest side of a steep hill. It is an adit striking northeast into the hill for a distance of 125 ft, and then turning east–southeast for 96 ft, with a vertical shaft to the surface at the intersection of the two tunnels. The opening is about 8 ft high and 5 ft wide.

The prospect was dug in 1917 and 1918, under the supervision of J. O. Whitlock, of Texarkana, Arkansas, who was hired by Arthur Givens and John L. Harpending, of Smithville, McCurtain County, Oklahoma. They supposedly were following an intersection of several quartz veins between the Johnson prospect and the Bellah Mine. The veins are in the middle Stanley Group, in quartzites and phyllites. One quartz vein strikes SSW along the creek north of the house and is about 5 ft thick. Mr. Whitlock claimed to have found some graphite, and the prospect was then abandoned. Mr. Higgins related the firsthand history of this prospect to me and supplied the background history of the Givens and Johnson prospects also. No mineralization was seen, and no samples were collected.

Hollingsworth Prospect

The Hollingsworth prospect is in the NW¼NW¼SW¼ SW¼ sec. 4, T. 7 S., R. 32 W., Sevier County, Arkansas (Figs. 2, 6). It is an east–west adit into the bank of Robinson Creek, along a quartz vein in phyllite and quartzite of the middle Stanley Group. It is presumed that this was dug about the time of World War I.

Johnson Prospect

The Johnson prospect is near the CSW¼SW¼ sec. 16, T. 5 S., R. 27 E., McCurtain County, Oklahoma, on a small branch of Pero Creek, about 1,000 ft north of the Pero Cutoff Road (Figs. 2, 6, 34, 35). An old logging road trends northward from the Pero Road, continuing almost to the prospect, which is within the Chapel Hill 7.5′ topographic quadrangle.

The site was discovered in 1916 by two deer hunters, Grover and Bob Higgins, who live at Cheatham, Sevier County, Arkansas, about 1.5 mi southeast of the prospect. They noticed a large green rock, about 5 ft high, and brought a sample back for analysis. They contacted a local mining engineer, Mead S. Johnson, of Wilburton, Oklahoma, who leased the prospect area in the spring of 1917.

The prospect is in quartz veins in phyllite of the middle Stanley Group. The bedrock strikes N. 80° W. and dips 35–75° N. Three pits were initially dug 10–25 ft deep, and one main shaft was sunk about 65 ft deep by 5 ft square. These have now been filled in, and the area has been bulldozed. Some of the exposed veins seem to strike N. 20° W. and dip 65° W., almost at right angles to the regional strike of bedding. The main ore is chalcopyrite, with minor amounts of galena and sphalerite (Fig. 35). According to Grover Higgins, large clusters of galena and sphalerite, 1–2 ft in diameter, were common at depth. The quartz veins are 1.5–5 ft thick, mixed with sandstone and quartzite.

I collected some spot samples from the exposed vein in July 1972, and these were analyzed by David Foster on December 5, 1975. The results are given in Table 1 (sample 18). Another set of atomic-absorption analyses were completed on April 24, 1975, on a quartz sample and a phyllite sample. The quartz-vein material contained 2.80% copper, 0.01% lead, and 0.17% zinc. The ore in phyllite contained 0.07% copper, 1.53% lead, and 4.36% zinc. Both samples contained <10 ppm silver. No gold was present.

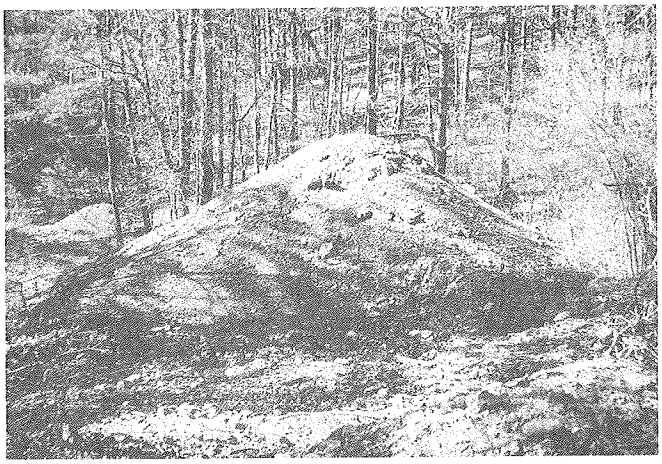


Figure 34. Johnson prospect. View looking north at tailings covering main shaft, near CSW¼SW¼ sec. 16, T. 5 S., R. 27 E., McCurtain County, Oklahoma. April 10, 1973.

Previous investigations are here summarized. The best historical résumé is that of Honess (1923, part 2, p. 35–36):

> North of Eagletown, in the SW¼ sec. 16, T. 5 S., R. 27 E.; in the spring of 1917 Meade Johnson discovered and began digging on a small vein of quartz containing chalcopyrite, pyrite, galena, and sphalerite. At the time of the writer's visit to the place in June, 1917, a hole about 5 feet square and 20 feet deep had been dug and preparations were being made for installing hoisting machinery and sinking a shaft. A few specimens were collected and the facts of the geology noted at this time, but how deep the shaft has been driven since that day, and what the finds in depth have been are not known. The present description is taken from the facts as observed and specimens collected in 1917.
>
> The country rock throughout the general region of the prospect is hard, gray, quartzitic sandstone, and hard, black slate or shale of the Stanley shale (Pennsylvanian) formation striking east–west and dipping 75° N. In the shaft the rock is a shattered blue-gray, quartzitic sandstone containing a number of small veins of milky quartz, and vugs of crystalline quartz. The sulphides occur sparingly and are associated with the shattered sandstone and quartz veins in a zone about a foot wide, the strike and dip of which is roughly parallel with the strike and dip of the bedding of the sandstones as near as could be determined. The vein could not be followed for more than a few feet either side the shaft. Chalcopyrite is the most abundant of the sulphides and it is intimately associated with the quartz gangue. The less common lead and zinc sulphides occur in very small amounts and there is a tendency for them to be more or less separated from the chalcopyrite and to occur in bunches up to a few inches across. There is scarcely any pyrite present, but what little there is

Figure 35. Johnson prospect. Samples of sphalerite, galena, chalcopyrite, malachite, and azurite in brecciated quartzite with vein quartz. Stanley strikes N. 80° W. and dips 35–75° N., but vein strikes N. 20° W. and dips 65° W., near CSW¼SW¼ sec. 16, T. 5 S., R. 27 E., McCurtain County, Oklahoma. April 10, 1973.

seems to be intimately associated with the chalcopyrite. Six ounces of silver per ton are reported to be present upon analysis of some of the ore, but this figure has not been verified by the Oklahoma Geological Survey. The chalcopyrite has altered somewhat at the surface yielding malachite and limonite.

In the fresh materials a thin coating of milky quartz usually encrusts the fragments of the brecciated sandstone indicating that the initial deposition was quartz. Chalcopyrite followed soon afterward and, contemporaneously with quartz, filled most of the cavities, yet leaving tiny vugs filled with crystals of quartz and chalcopyrite with occasionally a small speck of pyrite showing. The chalcopyrite is slickensided through faulting and the galena frequently is seen in small fissures in the chalcopyrite so that it is evident that some movement took place subsequent to the deposition of the chalcopyrite and that galena filled fissures formed at this time. It is not thought that all of the galena was precipitated after the second movement, however since there are intimate intergrowths of galena and chalcopyrite, the former predominating, in some places. Where sphalerite occurs it contains small inclusions of chalcopyrite and galena, indicating the rather late introduction of the sphalerite.

In [a diagram shown in this report,] worked out from thin sections and polished surfaces of the specimens the relative position of the individual mineral plats indicates the order (from left to right) in which the various minerals were deposited, their length represents duration of deposition while the vertical dimensions show the relative amounts of the respective minerals present in the sulphide bearing rock.

The vugs or cavities containing crystals of quartz and chalcopyrite were not filled with galena and sphalerite, it is believed, because the lead and zinc solutions happened to be traversing other channels when the precipitation took place.

Up to the time of its examination this prospect had not yielded all told more than a few hundred pounds of the sulphides.

On March 2, 1936, John A. Veeder, of the Oklahoma Geological Survey, visited the prospect and summarized his information on field sheet 94 (McCurtain County):

In 1917 a prospector by the name of Meade Johnson ran across small crystals of chalcopyrite and malachite. Upon tracing these two showings to a small quartz impermeated vein in the existing grayish quartzitic

rock a shaft was sunk to a depth of approximately twenty-five feet. In this distance stringers of chalcopyrite, galena, sphalerite, malachite, and pyrite were encountered, these minerals being sparingly distributed in the masses of quartz and quartzites. A small amount of the sulphide minerals were obtained in following the vein downward without apparently increasing with depth so further work was halted.

Two other pits were sunk to approximate depth of ten and fifteen feet adjoining the main hole in an effort to pick up the vein in a greater degree of enrichment without success, with further work being abandoned. These holes are at the present time filled with water and no further work has apparently taken place since the efforts of Mr. Johnson were discontinued.

The country rock throughout the region is hard quartzitic sandstones and black slates of the Stanley formation. This formation is turned very near on end with their dip averaging seventy-five to eighty-five degrees to the north–northwest with the formation striking in a general east to west direction.

In our visit to the mine efforts were spent in endeavoring to pick up the lead which encouraged the first efforts of exploitation. However, the vein could be followed only a few feet east and west of its present out break, apparently dipping into the mountains on either side.

The zone of mineralization from our observations would not exceed one and one-half feet in thickness as a maximum. Samples of the ore with their association with the gangue minerals and country rock were collected for further observation. Sample #94-1. [Lab. no. 7,231, dated July 28, 1937, on side.]

On August 6, 1941, Cliffort Merritt, William Ham, and Alan Herring visited the prospect, summarizing their report on field sheet 0434:

> Two shafts (now water filled). Country rock is hard, gray, quartzitic-sandstone and hard, black, shale-slate (Stanley). Minerals noticed in dump are quartz, chalcopyrite, pyrite, sphalerite, galena, malachite, azurite, limonite. Some chalcopyrite showed slickensides. The dumps have been combed over and are not now as representative of the ore as when visited by Honess in 1917. [Lab. no. 8836 on side of sheet. No analysis attached.]

Mill Creek Prospects

The Mill Creek prospects are a series of small diggings on the southeast side of the newly relocated Gillham Road, in the NE¼ sec. 29, T. 7 S., R. 32 W., Sevier County, Arkansas. These prospects were dug in sandstones and phyllites of the middle Stanley Group and appear to be on strike with the Bellah Mine. Most of the prospects are shallow diggings about 5 ft square. I found no mineralization except for some quartz veins.

Pearce Prospect

The Pearce prospect is a shallow hole about 5 ft square in the side of a hill in the SE¼NE¼NW¼NW¼ sec. 17, T. 7 S., R. 32 W., Sevier County, Arkansas, about 700 ft north–northwest of the Pearce cabin.

The prospect was dug about the time of World War I, and little is known of its history. The host rock is phyllite and sandstone or quartzite of the Stanley Group, with vein quartz. No samples were collected. Grover Higgins supplied most of the foregoing information.

Pero Creek Prospect

The Pero Creek prospect is in the NE¼NE¼ sec. 20, T. 5 S., R. 27 E., McCurtain County, Oklahoma. The discovery was made by John A. Veeder of the Oklahoma Geological Survey on April 11, 1936, and is recorded on field sheet 139 (McCurtain County):

> Hand samples of galena were collected on Pero Creek in the northeast quarter northeast quarter section 20 approximately one-half mile southwest of the above locality [Johnson prospect]. Time did not permit us to continue work in locating the source of this galena but it seems likely that the above described lead breaks out in this general region where samples were obtained. Further investigation may uncover the source of these samples.
>
> No other trace of any mineralization could be found in this township.

Petty Prospect

The Petty prospect is in the SE¼SE¼SE¼SE¼NE¼ sec. 21, T. 7 S., R. 32 W., Sevier County, Arkansas. It is in a ravine about 250 ft northwest of a house. The pit is 50 ft long north–south; it is 6 ft wide and about 30 ft deep on the south end, where the pit is inclined into the bottom of the ravine. This was first dug by Oscar Petty in about 1917 and was considered a promotional prospect, according to Dee Brewer, who lives south of the prospect. According to Stroud and others (1969, p. 374), this was a 12-in. vein, 15 ft deep, that was actively worked in 1937. About 4,000 ft^3 of rock was removed.

Hall (1940, p. 80) stated:

> This prospect was opened in the spring of 1936 by George Werner on the property of Oscar Petty in the SE¼NE¼ sec. 21, T. 7 S., R. 32 W. Both vein and country rock here strike N. 72° E., and dip S. 80°. The hole was sunk a maximum of 15 feet, up to abandonment, on a quartz vein 12 inches wide at the surface. No material of value was found. A few thin veinlets of marcasite occur as fracture fillings. Slickensiding on some specimens of vein material is an indication of faulting subsequent to mineralization. [George Werner was from Chicago, Illinois, and he opened and reentered many zinc and antimony mines and prospects from 1936 to 1939.]

The host rock is quartzite and phyllite of the middle Stanley Group, with some quartz veins. I collected a sample in June 1972, and David Foster analyzed the sample on June 2, 1975. The results are listed in Table 1 (sample 26).

Warford Prospect

The Warford prospect is in the SE¼SW¼NE¼SW¼ sec. 33, T. 4 S., R. 27 E., McCurtain County, Oklahoma. It

is a shallow pit about 10 ft square in rocks of the middle Stanley Group. The host rock is a quartz vein with pyrite in phyllite. Gordon Warford, who lives about 0.75 mi northeast of the pit, took me to the prospect. He did not know who dug the pit but stated that it was probably dug about 1917. I named the prospect after him, because he was the only person who seemed to know anything about it.

Miscellaneous Prospects

Several occurrences of sulfides have been noted in unpublished information of the Oklahoma Geological Survey. I have not verified these in the field, except for an odd rhodochrosite vein.

John A. Veeder reported on March 27, 1936 (field sheet 135, laboratory no. L 7237, NE¼SE¼NE¼NW¼ sec. 36, T. 5 S., R. 21 E., McCurtain County:

> Mineralization was found to have taken place in shales and sands of the Stanley formation on the southwest bank of Little River. At this locality beds of variegated colored shales and sandstones were found to dip at abrupt angles at a general northwestern direction while the formation was found to strike southwest into the banks of Little River where it was unconformably overlain by alluvial and Trinity sands of recent and Comanchean age. In a one foot area mineralization was found to have taken place, with many cubes of pyrite in a very poor state of preservation being found. This mineral was found to occur essentially in an unassociated manner scattered through a greenish colored sandstone associated with a thin layer of dark greenish dense basaltic appearing schist which in turn was associated with thin layers of red and green shales. Characteristic samples were obtained for investigation for other possible mineralization. Sample No. 135-1. [No analysis was given.]

Veeder also reported on March 20, 1936 (field sheet 124, laboratory no. L 7233, SE¼NW¼NW¼NW¼ sec. 21, T. 5 S., R. 22 E., McCurtain County, lower Stanley rocks associated with tuff):

> In a northwest–southeast bearing ridge consisting of dark blue hard quartzites a certain amount of mineralization was found to have taken place. The quartzites are impermeated by veins of milky quartz following the general direction northeast–southwest. In close contact with the quartz the country rock consisting of quartzite has undergone a certain amount of mineralization. From hard specimens obtained this mineral appears to be chiefly pyrite. Because of the possible association of other minerals a sample was obtained, Sample No. 124-1. The ridge where this occurrence was found extends for three quarters of a mile southwest with the quartz veins persisting throughout. Because of the extreme hardness of the quartzite surface observations were solely used at this time. [No analysis was given.]

Veeder reported on March 20, 1936 (field sheet 123, laboratory no. 7931, SW¼SE¼SW¼SW¼ sec. 26, T. 5 S., R. 22 E., McCurtain County):

> On the east bank of Horsehead Creek located in beds of the Womble sandstone and schist a vein of rhodochrosite and calcite occurs. The formation dips to the northwest at an angle of forty degrees with massive beds of the Upper Womble situated on the north. Underneath this sandstone and occurring in the thinner sandstone and schists the vein material was found. The vein is approximately fourteen inches in width consisting of rhombs of calcite and a brown calcareous mineral believed to be closely related to rhodochrosite. The vein material strikes off in an easterly direction from the bank made up of the Womble formation. Milky quartz was also found to occur with the calcareous material. A sample was taken. Sample #123-1. [No analysis was given.]

In a letter dated February 6, 1969, by Arel P. McMahan of the U.S. Bureau of Mines, several prospects were noted. In sec. 9, T. 14 N., R. 24 E., Adair County, east-central Oklahoma, is a lead and zinc prospect (not in the Ouachita Mountains). In secs. 19, 21, 22, and 27, T. 1 N., R. 26 E., Le Flore County, are lead prospects. In T. 3 N., R. 25 E., and T. 3 N., R. 26 E., Le Flore County, are lead and zinc prospects. I have not verified these.

On Rockpile Mountain in the SE¼SW¼NW¼SW¼ SE¼ sec. 3, T. 5 S., R. 25 E., McCurtain County, is a 10-ft hole at the top of the highest peak. This is part of old diggings by "Uncle" Johnny Beavers, in the lower Arkansas Novaculite. The beds strike N. 10° E. and dip 15° SE., with variations in strike from E–W to N. 50° W. and in dip from 15° to 45° N. and S. I collected samples in July 1972, and these were analyzed by David Foster on December 5, 1975. The results are listed in Table 1 (sample 5).

In the U.S. Army Corps of Engineers quarry in the NE¼ SW¼NW¼ sec. 4, T. 5 S., R. 25 E., McCurtain County, pyrite occurs in the Stanley shale. The rocks strike N. 80° W. and dip vertically. I collected some spot samples in June 1972, and these were analyzed by David Foster on June 30, 1975. The results are listed in Table 1 (sample 17).

I have not attempted to list the manganese prospects associated with the lower Arkansas Novaculite. Honess (1923, p. 42–47) is the best referance for these prospects.

A silver mine supposedly exists on the Kiamichi River in what is now Pushmataha County, about 60 mi up from the mouth near present-day Kosoma, according to J. Gaignard, 1773, in Bolton (1914, p. 83–84); a Francis Grappe and a Mr. Brevel, in Sibley (1805, p. 729); a Mike Hamby, of Kosoma, in Foreman (1938, p. 379); and Oklahoma Geological Survey Field Sheet, 1937, of Pushmataha County, Oklahoma where old pits were noted on the east bank of the Kiamichi in sec. 34, T. 2 S., R. 16 E. The upper Stanley dips 57°E here.

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